SEPTEMBER, 1934

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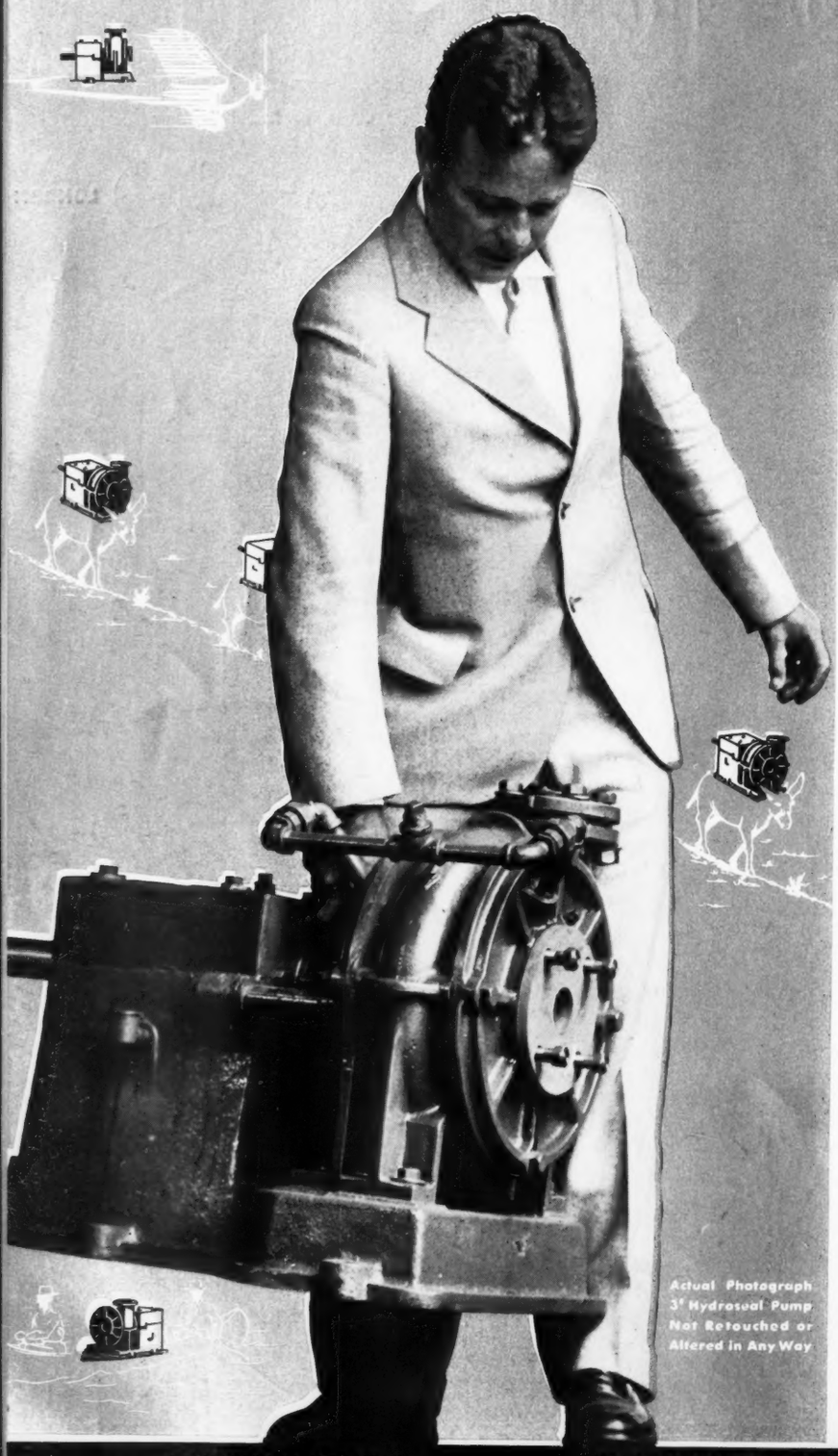

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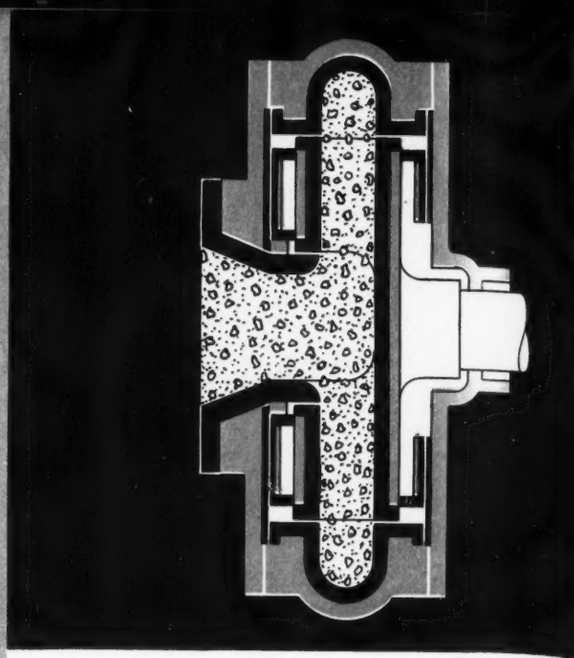

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H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

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CURRENT FEDERAL AGENCIES now number 48, in addition to NRA, according to the United States Information Service. All save six have been created by the present Administration. The revised list issued by the Service affords a welcome guide to the bewildering maze.

•

ORIGIN OF THE ALPHABETICAL HABIT is in doubt. Abroad, both industry and government have been addicted to it. The War begat DORA for England. German mining equipment manufacturers have long included DEMAG and CESAG, the latter meaning "Central Europäische Schwimm-aufbereitungs (flotation) A. G." But even earlier, people were saying "E&MJ," "AIME." and "Phi Beta Kappa," and the charming custom of appending letters to one's name began heaven knows when. At any rate, the habit is catching.

•

GEOLOGICAL AIR SURVEYS, LTD., of London, is mapping the Witwatersrand from above and at its own expense. The project is strictly business, the company having its eye on the advantages it will be able to offer the owners of the properties. The story will be published soon.

•

COPPER CONVERTING PRACTICE can be improved by use of oxygenated air, according to S. C. Tonakanov, of the Institute of Non-Ferrous Metallurgy, at Moscow. This he has shown by experiments employing air ranging from normal oxygen content (21 per cent by volume) to a mixture running as high as 38 per cent. He will describe his work in an early issue. Cheaper oxygen is necessary, he says, to make the process practical. Further progress would seem to be up to the manufacturer.

AERIAL TRANSPORT has proved economical in time and money, especially in mining work. A striking instance was afforded this summer when General McRae, of Vancouver, who is developing several properties in Alaska, flew to Fairbanks with his party in one day, and, after completing his work in the Territory, jumped by air to Aklavik, in northwest Canada, and thence to Great Bear Lake. What a journey this would have been by land and water!

•

THE COPPER CODE naturally holds the center of interest so far as non-ferrous metals are concerned, chiefly because of the elaborate marketing provisions. A sales executive associated with a domestic producer of copper was asked for his opinion of the code, and, not to be quoted, he confided that it is wonderful. "Just imagine being able to sit back in your office," he remarked, "and have no worries about disposing of your copper. Really, it seems like a dream."

•

IRON ORE TAXATION on the Mesabi has been getting a needed airing in court. Whether the system is good or bad, much money acquired by it has been spent in prodigal fashion by the communities of the Range—and this before the New Deal started. Town and village style will be somewhat cramped if any material reduction is made.

•

TUNNELING PERFORMANCE is often difficult to compare. Few operators, however, will challenge Cerro de Pasco's record for fast driving at an elevation of over 13,000 ft. At the end, the six-mile drainage bore was advancing 40 ft. per day, with a maximum rate of 50.4 ft. to the company's credit. Next month, full details will be given.

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Volume 135 SEPTEMBER, 1934 Number 9

Canadian Mining Industry Leads in Dominion Recovery

CANADA'S march toward economic recovery is unquestionably being led by the metal-mining industry. Confirmation of this statement was amply afforded by a recent visit to the principal mining areas in the southern provinces, where the activity in mining is in marked contrast to the depressed or dormant state of other industries in the Dominion. Lacking the facilities of extended travel, one could gain the same impression by studying the statistical abstract of Canadian industries, which reveals the upward trend of mining activity in the midst of economic depression. In a national economy predominantly agricultural, Canadian mining assumes a position of leadership.

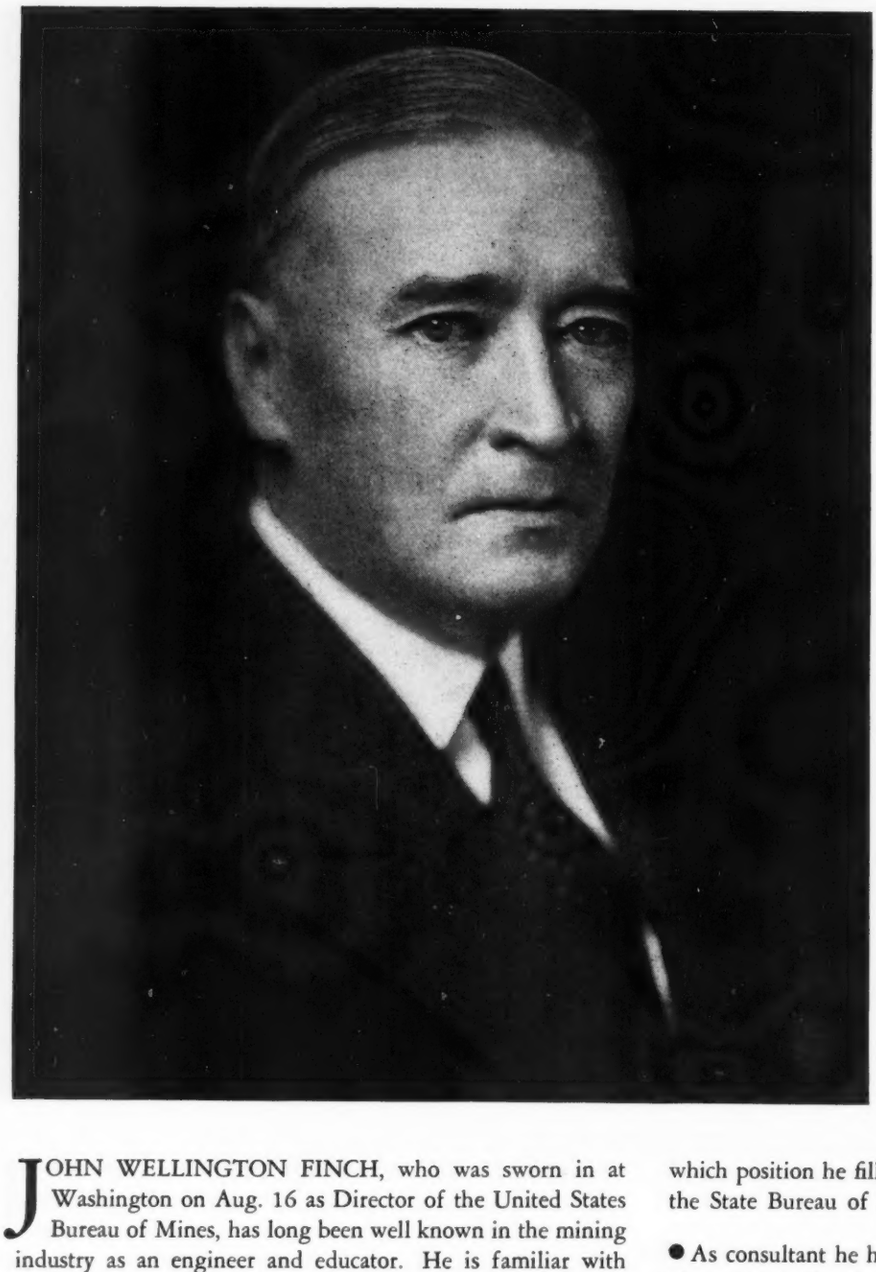
• Most important is the production of gold, nickel, and copper in the great Pre-Cambrian shield, comprising an area of about one million square miles surrounding Hudson Bay on the East, South, and West. The most remarkable series of discoveries in the recent history of Canadian mining has been made in this geological formation. Beginning with the finding of spectacular silver deposits at Cobalt in 1903, subsequent discoveries of gold at Porcupine and Kirkland Lake gave Ontario its present premier position in mining among the provinces. The earlier discoveries of nickel-copper deposits at Sudbury are world-famous, enabling Canada to produce 90 per cent of the world's supply of nickel.

• In the meantime the Canadian shield has yielded mineral wealth in provinces other than Ontario. At Flin Flon, in northern Manitoba, large bodies of gold-zinc-copper ore have been developed. In the Rouyn district of Quebec, almost due east of Kirkland Lake, are the Noranda gold-copper and the Siscoe gold deposits. Finally, in the Mackenzie district of the Northwest Territories, pitchblende-silver ores have been discovered at Great Bear Lake. These widely distributed mineral deposits are not only contributing to Canada's economic recovery, but they lend support to the belief of geologists that the Pre-Cambrian shield holds a wealth of undiscovered minerals that will further enrich the Dominion.

• In British Columbia, formerly the premier mining province of Canada, mining still holds an important position. In fact it is relatively more important in the economy of that province than of Ontario. Its metal resources are varied, yielding lead and zinc in addition to gold and silver. Metallurgy has reached a high pitch of perfection in the milling, smelting, and refining of lead-zinc ores by the Consolidated Mining & Smelting Company. Here also is an important unit of Canada's chemical industry producing ammonium sulphate and phosphate fertilizers, based on the utilization of roaster gas to make sulphuric acid.

• The record is an impressive one. A wealth of mineral resources, not without knotty technical problems, has been matched by the skill of Canadian technologists. Nor is the future left to take care of itself. An army of prospectors, estimated at 18,000, is in the bush this season, lured by the hope of mineral discovery. Whatever their success, it will redound to the credit of the mining industry as the most potent influence combating depression in the Dominion.

H. C. Parmelee



John Wellington Finch

Newly Appointed Director of the U. S. Bureau of Mines

◆

JOHN WELLINGTON FINCH, who was sworn in at Washington on Aug. 16 as Director of the United States Bureau of Mines, has long been well known in the mining industry as an engineer and educator. He is familiar with public office, having left the Directorship of the Idaho Bureau of Mines and Geology, which he filled from 1930 up until recently, to accept his new position. In 1901-1902 he was State Geologist of Colorado. His work as an educator has been extensive and his consulting practice has taken him into many widely scattered mining regions throughout the world, particularly in the Eastern Hemisphere.

● Dr. Finch was born in Lebanon, N. Y., in 1873, and attended Colgate University, receiving his Bachelor's degree in 1897, the Master's degree in 1898, and that of Doctor of Science in 1913. He taught geology and physics at his Alma Mater after his graduation, and the following year was instructor in geology at the University of Chicago, where he held a fellowship. In 1926, after years of experience in consulting work, he became professor of geology at the Colorado School of Mines, remaining at Golden until 1930, when he became Dean of the Idaho School of Mines, at Moscow, which position he filled concurrently with that of Director of the State Bureau of Mines, already mentioned.

● As consultant he has been retained at various times by the Guggenheim Exploration Company, Venture Corporation, of London; the Anaconda Company, J. P. Morgan & Company, William Boyce Thompson, the Newmont Mining Corporation, and other interests. From 1916 to 1922 he was vice-president and general manager of the New York Orient Mines Company, and during this period engaged in exploration work in China, Siam, India, Turkey and the Near East, and Africa. From 1922 to 1925 he was industrial adviser to the Governor of Yünnan, China, and since 1920 he has been the vice-president of the Yünnan Ming Hsing Mining Company.

● Contributions to scientific literature entitle Dr. Finch to a place in the fraternity of writers. He was also chairman of the committee of geologists who edited the well-known volume entitled "Ore Deposits of the Western United States" that appeared earlier this year. His varied experience fits him peculiarly for his new duties.

The Koepe Hoist,

Equipped With the Ohnesorge Pulley, Invites New Consideration

Theodore Simons
Professor of Mining Engineering
School of Mines
Butte, Mont.

Gerhard Grassmueck
Dipl. Ing., Freiberg School of Mines;
Exchange Student, School of Mines,
Butte, Mont.

Defects that were formerly thought by many operators to counterbalance or outweigh the system's admitted advantages are said to have been removed by its most modern improvement, the work of a German engineer

MOST AMERICAN engineers who have inspected and studied hoisting operations at German mines (especially coal mines) during the last three or four decades cannot help wondering why the extremely simple, inexpensive, and widely used system of hoisting with so-called "Koepe hoists" has never found introduction in American practice. We believe that a study of the design and operating principles of the Koepe hoist in its original form will best illustrate the undesirable and objectionable features that mitigated against its adoption in America and in most other countries outside of Germany. A few Koepe hoists have been installed in England[1], Holland, Poland, and France.

As there is no likelihood that a Koepe hoist in its *original* design will ever find use in American mines, only those features of the hoist will be described that emphasize the defects which had to be overcome to make the system universally acceptable and profitable in general hoisting practice.

The widely used belt and rope drives had demonstrated that energy may be transmitted from one body to another not only by solid connections but by friction alone. This principle was first applied in 1877 to the operation of a hoisting cable by Frederick Koepe, a German engineer, who employed a single-grooved rope wheel or "driving sheave" (A) in place of a drum, Fig. 1. A continuous rope passes from the top of one cage in one compartment of the shaft over a head sheave (B) to the driving sheave (A), thence around this wheel to the head sheave (C), down to the top of a cage in the other compartment of the shaft. The cable encircles slightly more than half of the periphery of the driving sheave (A), which is revolved by an engine or motor.

In a typical Koepe wheel, the rope itself is driven by friction between the rope and the grooved lining, usually made of wood and other frictional material. To avoid excessive crushing action by the pressure of the rope on this lining, Koepe wheels must be made of large diameter (from 15 to 25 ft.)—much larger than would be required merely to take care of the bending stresses of the rope.

To equalize the weights of the rope in each compartment of the shaft, a long tail rope is employed which is an essential and indispensable element of a Koepe hoist.

By an ingenious mechanism, the number of wraps of the rope about the pulley is increased, thereby raising the value of the driving factor. The rope also is made to stay in the centre of the pulley and to travel in the vertical plane laid through the head sheaves. The authors think the new development offers to some the opportunity of reducing the cost of hoisting

Fig. 2 shows a Koepe hoist built by Siemens for a coal mine at Gelsenkirchen, Germany. The wheel is 23 ft. in diameter. The electric drive is of the Ilgner system. Depth of shaft is 2,000 ft. Maximum hoisting speed 65 ft. per sec. Capacity 200 tons per hour.

To prevent the rope from slipping in the driving sheave, theoretical mechanics demand a definite ratio between the pull (S_1) of the loaded rope and the pull (S_2) of the unloaded rope. This ratio is:

$$\frac{S_1}{S_2} < e^{f\pi n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which e = base of Naperian logarithm = 2.718
f = coefficient of friction between rope and lining of rope wheel
π = 3.146
n = number of *half laps* of rope about the driving sheave

Evidently, the ratio $\frac{S_1}{S_2}$ can be made smaller by adding an equal amount of dead weight to both rope pulls, a very undesirable procedure in all hoisting operations.

Calling $\frac{S_1}{S_2} = \frac{10}{5} = 2$, for instance, then $\frac{10+5}{5+5} = 1.5$, and so forth, showing that theoretically the ratio can be decreased to any desired value by increasing the dead weights on either side of the hoist. This is the reason why for shallow shafts, necessitating a shorter and therefore less heavy tail rope, the danger of "slipping" of the rope in the driving sheave (A) is much greater than for deeper shafts where the slip can be kept within very small limits. In

[1] *Colliery Guardian*, Vol. 134, pp. 26 (1927).

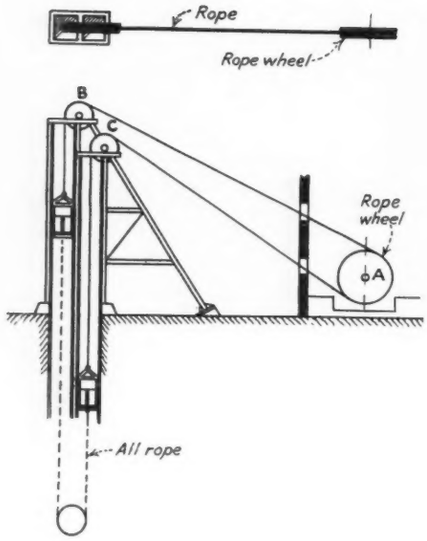


Fig. 1—Sketch illustrating earliest application of Koepe principle

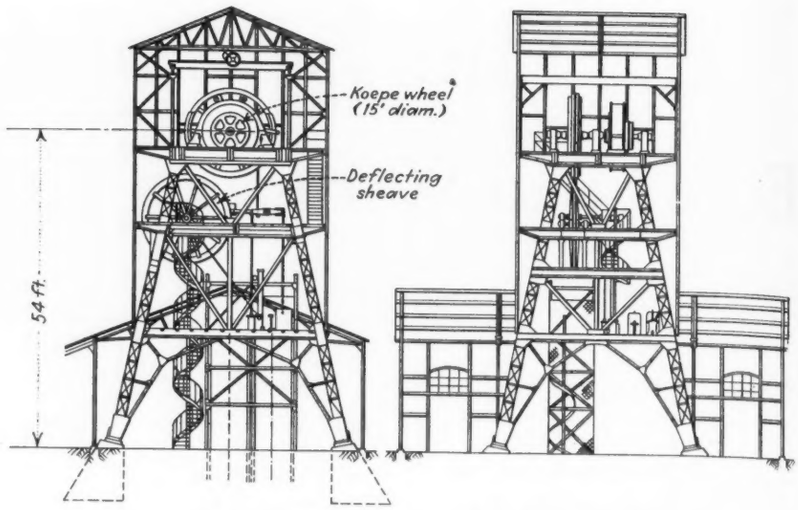


Fig. 3—Headframe at a German coal mine having electric hoist directly over shaft

the great number of existing Koepe installations, especially in Germany, the daily adjustments for rope-slip made by experienced and trustworthy drivers have caused neither delays in operation nor especial difficulties. Nevertheless, the ever-present possibility of rope-slip has been considered by all engineers as the outstanding defect of the Koepe system of hoisting.

For any given values of S_1 and S_2 the ratio $\frac{S_1}{S_2}$ becomes proportionately smaller than the right-hand member of Equation (1), and the danger of rope-slip increasingly less, the greater the value of (f) or (n) or both. Hence, the numberless devices, developed chiefly by German engineers and inventors, tending to increase the friction (f) between the rope and pulley by special kinds of lining; or devices that pinch or grip the rope, or increase the arc embraced by the rope around the pulley, as, for instance, by deflecting sheaves (Fig. 3). All these devices, however, have not contributed toward overcoming the original defects of the Koepe hoist without adding new and undesirable features; most of them achieved their object at the expense of a considerable wear of rope, the life of which, for reasons herein to be explained, is already much shorter than that of ropes used in drum-hoisting. No attempt is made in this paper, therefore, to enumerate or describe these devices.

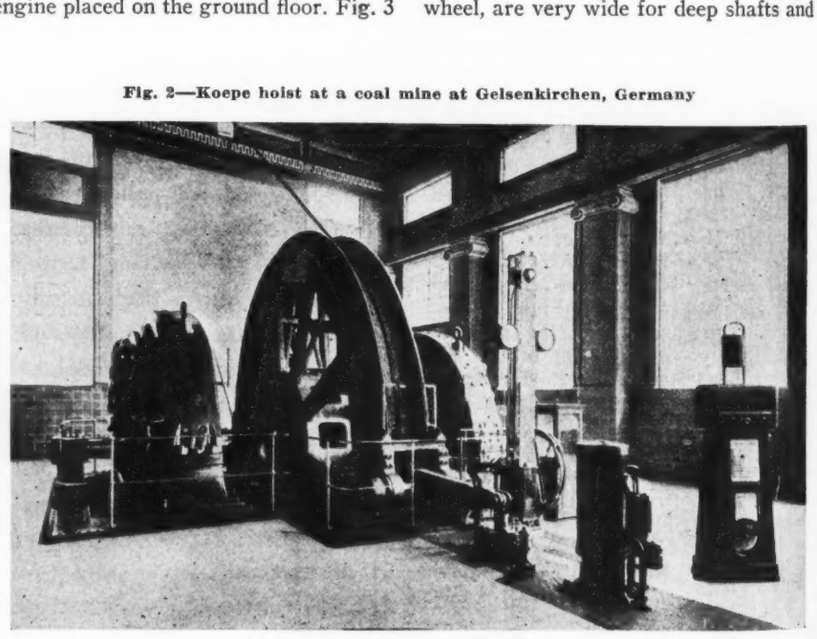
The Koepe system has the advantage that the exact maximum depth of the shaft need not be known when the plant is installed, as more rope can be added to suit requirements. The fact that only one narrow, light, driving sheave is required for balanced hoisting in two compartments of a shaft materially reduces installation, foundation, and housing costs. Consumption of power is small, owing to the theoretical perfect balancing of the moving masses, excepting the useful material being hoisted, and the engine or motor is easily controlled on account of the low moment of inertia of the driving sheave. There is no fleet angle between the head sheaves and the rope wheel, a circumstance which permits the engine to be placed close to the shaft.

The introduction of electric drives, with their compact construction, has made possible the placing of the hoisting engine in the gallows frame directly over the shaft. This may reduce installation costs by eliminating floor-space requirements, separate buildings, and foundations. Headframes, however, must be made somewhat higher and heavier than would be necessary for an engine placed on the ground floor. Fig. 3 illustrates such an installation at a German coal mine. The electric drive is of the Ilgner system with a d.c. motor on the shaft of the Koepe wheel. Fig. 4 illustrates a reinforced-concrete construction for a "tower plant" at a coal mine in Holland.

Hoisting plants placed directly over the shaft are not unknown in American practice. The primitive windlass is such a plant. In some mining districts—the Joplin district of Missouri, for instance—hoisting engines are placed in the gallows frame 60 ft., and more, directly above the shaft to allow the hoistman to watch the travel of the "tub" in the shaft and its arrival at the top.

Equalizing of the load moments during the hoisting cycle has been accomplished in American practice by the use of cylindro-conical drums, which, compared with the narrow and light Koepe wheel, are very wide for deep shafts and

Fig. 2—Koepe hoist at a coal mine at Gelsenkirchen, Germany



present enormous masses to be accelerated and retarded. Moreover, their difficult construction makes them expensive.

As stated, the great number of Koepe installations in German mines, exceeding all other systems of hoisting for main shafts, high hoisting speeds, and great output, seem to indicate, however, that careful and experienced operators and certain improvements in indicators have reduced the danger of rope-slip to a minimum.

As no extra turns of rope can be stored on the Koepe wheel, the practice of occasionally cutting off part of the rope near the cage for examination and safety is excluded. Hence, the rope must be renewed more frequently than with cylindrical drums. Adjustment for rope-stretch cannot be performed by the wheel but must be made on the rope itself. Lubrication of the rope for protection against the usual deteriorating influences in operation is likewise excluded, although certain so-called "adhesive" lubricants have been developed which are claimed to furnish the desired protection for the rope without increasing the rope-slip in the driving sheave such as the regular lubricants would produce.

What may be considered another disadvantage of the Koepe system is the fact that hoisting from more than one level has proved not to be practicable with that system.

We believe that a perusal of the foregoing description of the Koepe hoist in its original form, of its undeniable advantages and disadvantages, will help to explain the principal reasons for its failure to find introduction in American practice. These are:

1. The necessity of a long and heavy tail rope presumes shafts having a depth of not less than from 800 to 1,000 ft. Few, if any, American coal mines have reached such a depth.

2. On account of the American engineer's predilection for maximum safety and uninterrupted operations, the ever-present danger of rope-slip in the original Koepe hoist, with its undesirable and possibly disastrous consequences, has been and always will be sufficient reason for rejecting the system as being inadequate and unsuitable for American practice.

We also believe that the reader is now prepared to appreciate the radical and promising features of what we regard as the most modern improvement of the Koepe hoist—namely, the "Ohnesorge" pulley.

The statement has been made that, other things remaining the same, the value of what may be called the driving factor, $e^{f\pi n}$, in Equation 1, may be increased and the danger of rope-slipping thereby reduced, by merely increasing n—that is, the number of half-laps of rope about the sheave. Devices for increasing the coefficient of friction f or

Fig. 4—Reinforced-concrete construction for a "tower" plant at a coal mine in Holland

pinching the rope have proved either unreliable or simply harmful.

So-called balanced hoisting from shallow shafts using friction alone has been

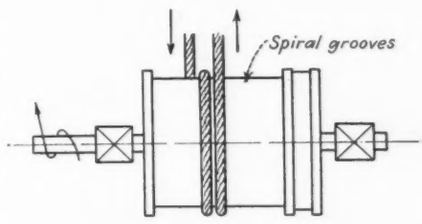
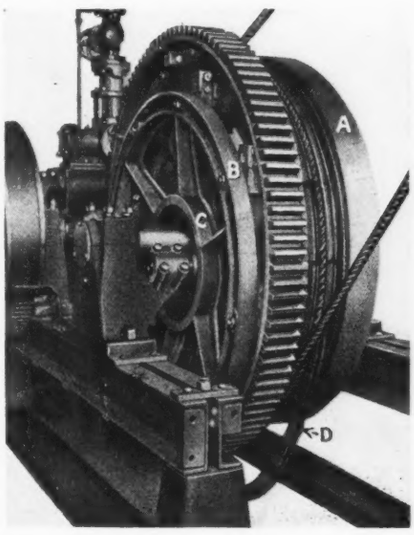


Fig. 5—Single drum keyed to shaft and provided with spiral steel grooves as a means of balanced hoisting for shallow shafts

Fig. 6—The Ohnesorge pulley. A, Brake ring. B, Steering wheel. C, Hug ring. D, Shoe-chain



practiced for some time in various mining districts. A single cylindrical drum (Fig. 5) keyed to the shaft is fitted with steel grooves carved spirally around the face of the drum. A continuous rope makes a few wraps about the drum to create the necessary friction. During hoisting or lowering, the wraps travel back and forth across the face of the drum, thereby increasing or decreasing the fleet angle between drum and head sheaves. This fact limits the amount of rope that may be used on a drum of reasonable width, thus confining this system to shafts of limited depth, besides requiring the hoist to be placed at considerable distance from the shaft. This compares unfavorably with the Koepe pulley, in which there is no fleet angle, permitting the hoist to be placed close to the shaft.

To increase the value of the driving factor by increasing the wraps of the rope about the pulley, and at the same time compel the rope itself to remain in the center of the pulley and to travel always in the vertical plane laid through the head sheaves, as in the original Koepe hoist, the Ohnesorge pulley has been developed (Fig. 6), named after its inventor, Otto Ohnesorge, Dipl. Ing., at Bochum, Germany. The pulley is patented in the United States and in Europe.

The ingenious mechanism, designed to accomplish the objects mentioned, is one of the outstanding novelties of the Ohnesorge pulley that distinguishes it from the original Koepe pulley and helped to eliminate practically all the latter's disadvantages and objectionable features.

Instead of allowing the rope to wander forth and back on the face of the drum, as illustrated in Fig. 5, the Ohnesorge pulley uses a set of independent, semicircular grooves in the form of an endless "shoe-chain," slung spirally a number of turns about the face of the pulley (Fig. 7), the loop of the chain hanging freely down at the bottom of the pulley.

The number of turns of the shoe-chain depends on the number of complete rope turns that are required for any particular problem. For one complete and one half-turn of rope, three chain turns must be on the pulley, as shown in Figs. 6 and 7. For two complete and one half turn of rope, four chain-turns must be on the pulley, as shown in Fig. 10.

The shoe-chain, as shown in Fig. 7, is made of a number of individual links. The inside of the links facing the worm screws have a projection (A) that fits into the threads of the worm screws, as shown in Fig. 7. The links located between the worm screws may have a rectangular recess (B) that fits upon a projecting rectangular cleat on the face of the wheel, as shown in Fig. 10. In this manner the chain is kept from slipping on the face of the wheel.

Located along the circumference of

the pulley are a number of worm screws which engage the inside face of certain links of the chain as shown in Figs. 7 and 10. The pitch of these screws is equal to the width of the chain links. One side of each screw or worm shaft ends in a crank or radius (r), Fig. 7. A single eccentric steering wheel hangs freely from the pins of these cranks. It therefore revolves with the main pulley about its own axis, the eccentricity of which, referred to the axis of the main pulley, is equal to the length (r) of the cranks.

The hub ring (Fig. 7) of the steering wheel, and, therefore, the wheel itself, are kept in proper position by small rollers whose shafts revolve in bearings (C), which are an integral part of the bearings of the main pulley (Fig. 7). With this arrangement, one revolution of the main pulley causes the worm screws (Fig. 7) to make one complete revolution in a direction opposite to that in which the rope would tend to wander. The pitch of the screws being equal to the width of the chain links, the chain with its supported rope is always kept in the same position—that is, in the center of the main pulley. As a consequence, there is no fleet angle, a fact that permits the hoist to be placed as closely to the shaft as desirable, or above the shaft in a tower as in Figs. 3 and 4.

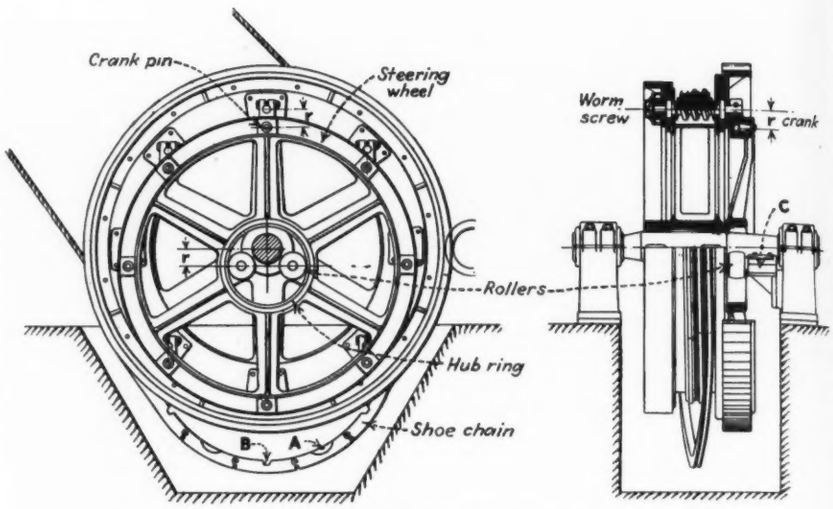


Fig. 7—The endless "shoe chain," which serves on the Ohnesorge pulley as a set of independent, semicircular grooves for the endless rope

The shoe-chain never runs off the pulley and the loop of the chain on its bottom never gets entangled, because the centrifugal force stresses the chain, the more the higher the speed. The chain rests wholly on the pulley's body, so that no pressure on and no wear of the revolving worm screws occurs (note Fig. 10). Advantages of the Ohnesorge pulley are:

1. For any given case a sufficient but not excessively high frictional grip of the rope on the pulley may be obtained. By experiment, the coefficient of friction (f) for an Ohnesorge pulley has been found to average 0.136.

Thus the driving factor $e^{f\pi n}$ is: For $1\frac{1}{2}$ rope turns (n=3), 2.718 $^{0.136 \times 3.14 \times 3}$ = 3.3. For $2\frac{1}{2}$ rope turns (n = 5), $e^{f\pi n}$ = 7.5.

Knowing the maximum rope pulls S_1 and S_2, one may make the driving factor sufficiently large by using one or more turns of rope about the pulley. This permits high-speed hoisting in both shallow and deep shafts and elevators without danger of the rope slipping, even without a tail rope. This lessens the time consumed per trip and permits greater acceleration and retardation even in shafts exposed to considerable ground pressure. This has been proved experimentally with an Ohnesorge pulley in crooked raises 300 ft. deep without incurring any difficulty or mishap.

2. The diameter of an Ohnesorge pulley will be considerably less than that of a Koepe pulley doing the same work; only large enough to take care of the bending stresses of the rope. This ma-

Comparative Data, Drum Hoist vs. Ohnesorge Pulley

	Drum	Ohnesorge Pulley
Depth of shaft, ft	1,392	1,392
Maximum rope pull, lb	16,000	16,000
Diameter of drum or pulley, ft	19.2 (a)	13.5
Steam engine, length of stroke, in	64	64
Steam engine, diameter of cylinder, in	38	38
Steam pressure required, in atmosphere	9.85	7.5
Steam consumption, lb. per shaft, horsepower hour 10 atmospheres pressure, 250 deg. C	(not available) 34	(available) 28
Safety against rope slipping at 6 ft. / sec.² acceleration and retardation	.....	1.43

a Large diameter to limit piston speed.

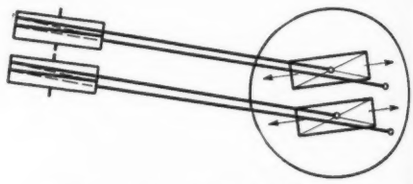
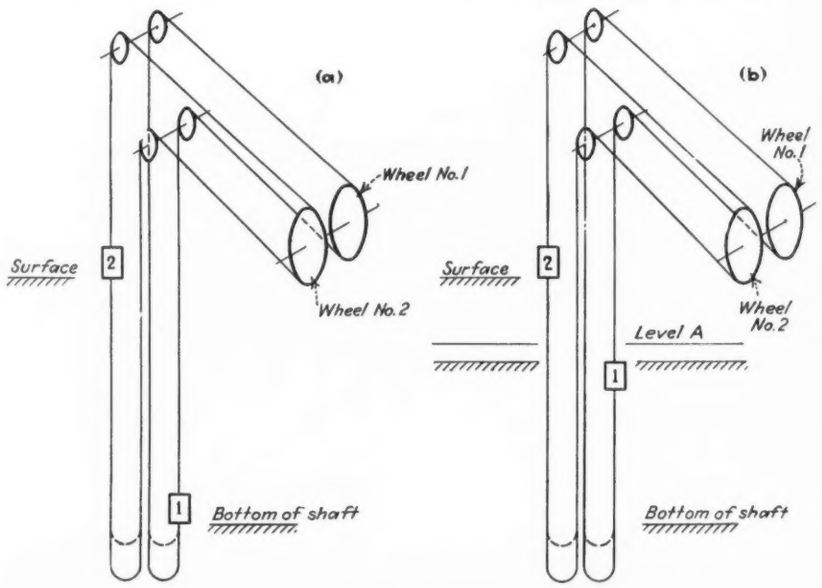


Fig. 9—Two-pulley hoisting engine placed at angle to shaft, so as not to hinder loading or unloading of cage

Fig. 8—Two cases of hoisting from different levels with the Ohnesorge pulley



terially reduces the masses to be accelerated and retarded, resulting in a great saving of power. Moreover, the required size of engine or motor will be considerably smaller, requiring smaller and therefore less expensive foundations.

3. Wear of the rope on the Ohnesorge pulley, compared with the excessive wear on a Koepe pulley, is reduced to a minimum. No pinching or squeezing of the rope takes place in the semicircular, hard-steel shoe-chain, which fits the rope snugly. This results in increasing the rope life to that of ropes used with cylindrical drums.

4. The frictional grip of the rope being due entirely to the turns of the rope about the wheel, and not to the coefficient of friction, smooth, semicircular, steel grooves may be used, which make the system independent of the pressure of the rope on the wheel; that is, of depth of shaft and weight of rope and load. This eliminates also the necessity of a tail rope, although its use for compensating the load moments is not excluded. Cages, cars, and skips may be made of lighter alloy metals.

5. Elimination of rope-slip in an Ohnesorge pulley being practically independent of the coefficient of friction, perfect lubrication of the rope is permissible.

6. Hoisting with skips of light material is possible with the Ohnesorge pulley. With the Koepe pulley this could not be practiced satisfactorily, because, when discharging the upper skip, the rope pull against the skip at the bottom of the shaft decreased so much as to make rope-slip imminent.

7. Hoisting from different levels. No simple and satisfactory methods have ever been developed for hoisting from different levels with the Koepe pulley. The use of the Ohnesorge pulleys, however, makes this possible in the manner illustrated in Fig. 8, *a* and *b*.

Two pulleys (1 and 2) are placed on the same shaft and are provided with clutches so that each pulley may be operated independent of the other. Each pulley carries its own endless rope. In Fig. 8 *a* cage or skip 1 is at the bottom of the shaft, ready to be loaded while cage or skip 2 is on the surface ready to be discharged. If the wheels are now turned in a counter-clockwise direction, skip 1 is pulled to the surface while skip 2 descends to the bottom of the shaft.

If it is desired to hoist in balance from an intermediate level, *A*, for instance Fig. 8 *b*, when skip 2 is on the surface the brake is applied to wheel 2 and the latter is unclutched from the shaft. Wheel 1 now pulls skip 1 to the level *A*. Thereafter, wheel 2 is again clutched to the shaft, the brake is released, and hoisting starts in the usual manner between level *A* and the surface. The same method is applied to hoisting from any other levels.

The objection that the two-pulley system with two separate ropes might hinder the loading or unloading of the cage is met by placing the hoisting engine at a certain angle to the shaft, as shown in Fig. 9.

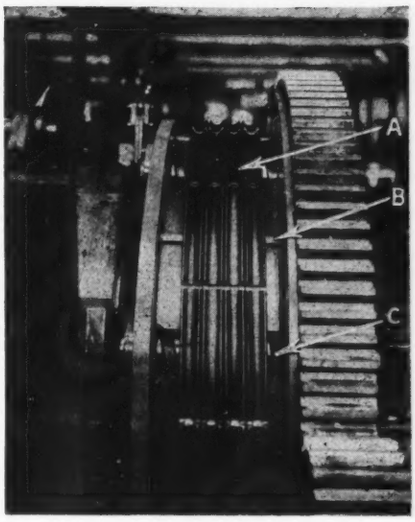


Fig. 10—This Ohnesorge pulley shows four turns of the shoe-chain, sufficing for two complete turns and one half turn of the rope. A, Shoe-chain. B, Cleat. C, Worm screw

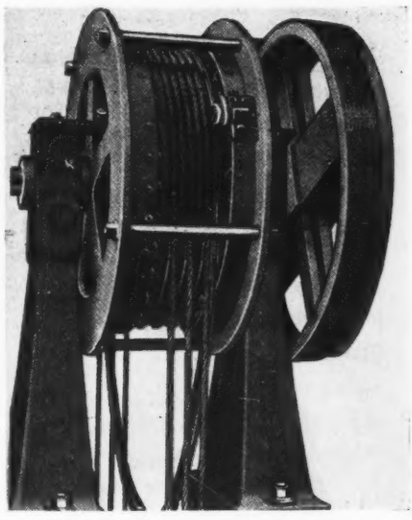


Fig. 11—Simple rollers serve to keep shoe-chain in middle of pulley when two or more ropes are used

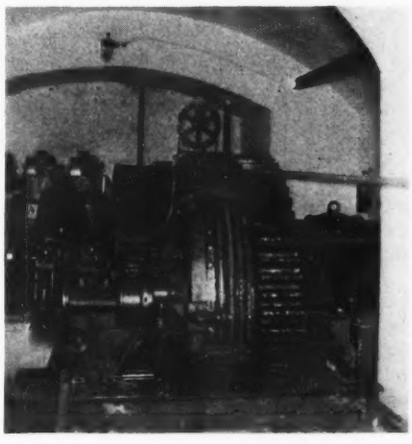


Fig. 12—Ohnesorge pulley serving horizontal rope-haulage system in a mine in Poland

8. The use of two Ohnesorge pulleys also permits the occasional cutting off of a certain amount of rope near the top of cage or skip, for safety and for testing. Referring to Fig. 8 *a*, skip 2 is held in its position by any suitable means. Pulley 1 is unclutched from the shaft, and pulley 2, by being revolved in a counter-clockwise direction, lifts up the bottom loop of the rope into a position indicated by dotted lines. This adds an extra length of rope to the section between the top of skip 2 and the corresponding head sheave, and permits an equal amount of rope to be cut off and replaced by the added extra length. The same method is applied to the rope carrying skip 1.

9. The fact that the Ohnesorge pulley may be operated with not only one rope, but with two or more ropes, makes it particularly suitable for elevators. Elevator pulleys with several parallel grooves have the defect that the uneven wear of the grooves soon changes the lengths of the different ropes, with the resultant uneven distribution of the weight of the elevator among the different ropes.

With Ohnesorge pulleys using two or more ropes, the shoe-chain is kept in the middle of the pulley by simple rollers, located around part of the inner rim of the pulley's circumference (Fig. 11).

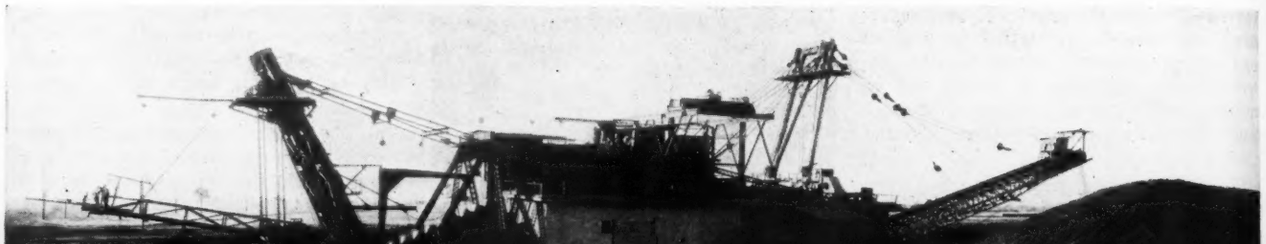
From the preceding brief description of the Ohnesorge pulley and its principles of operation, one can see that the pulley is applicable not only to hoisting from vertical and inclined shafts, but also to rope haulage in horizontal workings of a mine. Fig. 12 illustrates such an engine installed in a mine in Poland.

Comparing a drum hoisting plant with an Ohnesorge pulley plant that was to replace the former on the same shaft and using the same engine, the manufacturers of the Ohnesorge pulley gave the data presented in the accompanying table on page 390.

The cost of an Ohnesorge pulley, complete with brake ring and gear wheel, in Germany in 1932, ranged between $700 for a wheel 40 in. in diameter and for a rope 1 in. in diameter, and $2,900 for a wheel 8.2 ft. in diameter and for a rope 1.6 in. in diameter. This price applied to wheels with three turns of the shoe-chain. For wheels with four turns, the price was $750 for the 40-in. pulley, and $3,050 for the 8.2-ft. pulley.

In the face of the constantly increasing operating costs in American mining practice, including the costs of hoisting, means for reducing the latter are highly desirable. The Ohnesorge pulley seems to offer these means.

We express to Mr. Ohnesorge our indebtedness for some of the illustrations presented in this paper.



Dredge Yardage Improved

By Adopting Automatic Control for Side-Line Winch Motor

Comparison with manual operation in making adjacent cuts between the same points showed an increase of 12 to 19 per cent in hourly production, depending on the nature of the ground

The saving effected was 0.29 cent per cubic yard, or approximately $10,000 per year

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MAXIMUM PRODUCTION in the operation of a gold placer dredge depends largely on proper design and expert handling of the equipment. An innovation that has increased considerably the production of the gold placer dredges of the Natomas Company operating in the Folsom area of California is the installation of automatic winch control on the side-line winch motor. This device has helped to remove some of the uncertainties due to the personal element in the handling of the dredge. As known, the dredge pivots at the stern about one of two massive steel poles or spuds dropped into the bottom of the pond. The dredge is swung sideways about this pivot by means of side lines secured to the lower end of the digging ladder and passing around sheaves on the shore back to the drums on the side-line winch, driven by a slip-ring motor.

Digging operations are started by stepping the dredge ahead until the bucket line projects into the gravel bank, and then pressing the buckets against one side of the cut by hauling in one side line and slackening the other. Proper filling of the buckets, of course, depends much on the skill of the winch operator. For instance, if the buckets are not pulled into the cut rapidly enough they will not be filled to capacity; whereas overloading, with consequent wear, will result if the buckets are advanced too fast.

Frequently, when the dredge is stepped ahead for the next cut, the spud is so placed that the arc followed by the digging ladder is not parallel with that of the previous cut. This produces, in dredge parlance, a "wedge cut," or a cut which is deep at one end and shallow at the other. In this case the bucket line must be advanced faster as it approaches the shallow end of the cut and retarded when nearing the deep end of the cut. This means that the speed of the winch motor must be increased when working toward the shallow end, and decreased at the deep end, if the buckets are to be filled to capacity and wear is to be reduced to a minimum. An alert winch operator would change the speed of the winch motor according to requirements. However, experience has shown that, owing to the human element involved, this ideal can never be maintained with manual winch control in average ground.

The equipment and operation of gold placer dredges have been standardized for many years, and most operators believe that the ordinary method of manual operation, although not perfect, was about the best that could be done. The management of the Natomas Company, however, felt that some improvement in yardage was possible by using automatic control on the winch motor, and accordingly presented the problem of developing such a control to the electrical manufacturer.

On first consideration it would appear that, inasmuch as the problem is to keep the load in the buckets constant, the power taken by the digging motor should govern. However, preliminary tests seemed to indicate that better results could be obtained by allowing the winch motor to govern. Experience with automatic control confirms this conclusion.

The load on the digging motor is made up of three components:

1. A relatively large mechanical friction load
2. Load due to actual lifting of material against gravity
3. A relatively large pulsating component caused by the successive buckets striking into the bank

The component due to lifting the material is the only one that is nearly proportional to the volume of material in the buckets. This component is relatively small, because the material is not lifted vertically but at an angle varying from 15 to 45 deg. with the horizontal. Thus the gravity component is not even constant for a given weight of material in the buckets, but varies between 26 per cent and 70 per cent of the weight, depending on the depth of the bank.

As the side-line speed is increased, the pulsating component increases, but the time between pulsations, nearly three seconds, is so long that it is difficult to average this component with commercial relays.

In the scheme adopted finally, current relays are used in the winch motor primarily to hold the torque approximately constant by adjusting the secondary resistance in small steps. The speed can be regulated for approximately

constant torque by this method, because the torque tends to increase and decrease with the speed. If the winch motor is operating on a certain speed point at the regulated torque, and the digging gradually becomes shallower and the buckets are not filling, then the torque drops and the primary regulating relays function to cut out resistance. As the speed increases the torque increases somewhat until a speed is reached to bring the torque up to within the range for which the regulating relays are set.

The automatic winch control in its latest form consists of a motor-operated drum master switch, secondary contacts, regulating relays, and auxiliary relays, all mounted on a suitable panel as shown in the accompanying cut. The motor-operated drum is actuated by two sensitive but sturdy primary current relays, one of which functions to rotate the master switch to increase the winch speed, while the other reverses the drum movement to decrease that speed. Time-element auxiliary relays are provided, which function between each step to damp out momentary fluctuations and prevent shunting. The pilot motor and the control circuit are supplied with direct current from a rectox rectifier. This permits the use of an adjustable-speed pilot motor that also can be stopped by dynamic brake, making faster drum speeds possible. The d.c. control also permits the use of a simple and sturdy type of auxiliary timing relays.

Automatic winch control is used in combination with the existing manual drum controller and resistor. The arrangement is such that the automatic control is actuated only when the manual controller is on the first point forward. When the manual controller is moved to any other point, the control of the winch is entirely in the hands of the winch operator. The automatic control can also be disconnected on all points by a pushbutton near the manual controller.

In dredging an area, the usual practice is to run the dredge through one way from one end to the other and then back in an adjacent cut. The geological formation will vary in different parts of a property, but will average about the same in adjacent cuts between the same points. Therefore, to make a comparison of yardage, the comparison on adjacent ground must be made in this way. In a fifteen weeks' run prior to the installation of the first automatic winch control, hourly production averaged 366 yd. In thirteen weeks immediately after installation of the automatic control, when returning over adjacent ground, hourly production rose to 434 yd. This is an increase of nearly 19 per cent, with a proportionate decrease in time to cut through the same length of ground. The ground in question would be classed as a sticky clay and gravel formation. In a medium clay and gravel formation the average yardage before and after the installation of the automatic control was 403 yd. and 450 yd. respectively, or an increase of nearly 12 per cent. This increase in yardage is not obtained without some increase in operating costs. However, the increase in costs is not in proportion to the increase in yardage, and the fixed charges remain constant. Only two items of operating costs are increased with the increase in yardage:

1. Power
2. Certain repair materials—that is, bucket lips, screen plates, and stacker belts

To make these observations more concrete, I shall assume some figures based on the actual operation of the Natomas dredges. With manual control assume:

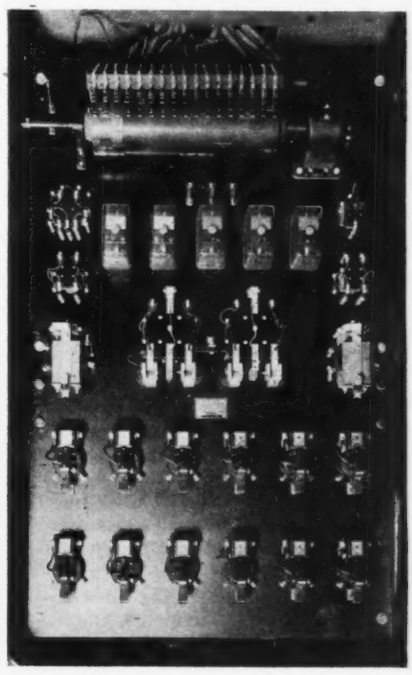
Total yardage per year for dredge	3,000,000
Total cost of power per year for dredge	$ 40,000
Total repair cost per year for dredge	$ 42,000
Total yearly operating cost for dredge	$140,000
Average cost per yard, cents	4.66

After installation of the automatic control assume:

Increase in cost of power of 7 per cent	$ 2,800
Increase in repair material cost of 10 per cent	$ 4,200
Increase in total operating cost per year	$ 7,000
Total operating cost per year for dredge	$147,000
Total yearly yardage of dredge assuming an average increase of only 12 per cent	3,360,000
Average cost per yard, cents	4.37

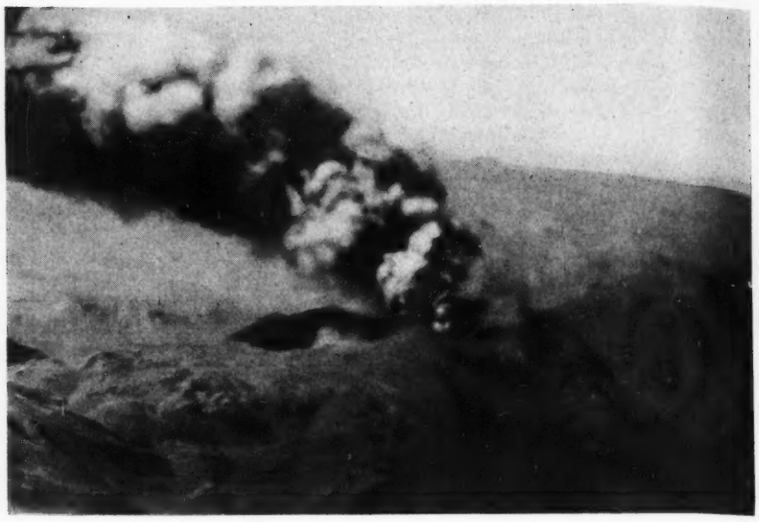
This shows a saving of 0.29c. per cubic yard, or about $10,000 per year in operation alone. In addition, the automatic control must be credited with the interest on 12 per cent of the total profits left in the ground which this dredge will work, because the total profit will be made available 12 per cent sooner. The figure of 10 per cent assumed for increase in repair material is thought to be too high. No actual figures are available as yet.

The saving to be obtained by the use of automatic winch control depends largely upon the nature of the ground. If this be uniform and easy to handle, no startling gains in yardage can be expected. However, in hard digging, or in ground that is spotted with hard and medium digging conditions, which is representative of the average dredging property, actual experience shows that the automatic winch control will increase profits.



Automatic winch control panel. The equipment includes a motor-operated drum master switch, secondary contacts, and regulating relays

In the pilot house of the dredge. The drum controller is in the center. At the left is the automatic control panel. A loaded bucket may be seen through the window



Airplane view of one of the recently active volcanoes in south-central part of Chile.

An Hypothesis As to the Origin of Gold in Volcanic Ash

Extensive deposits of Central Chile appear generally to contain a small quantity of the precious metal

Although the value per ton is commercially uninviting, the gross content may be so large as to provide an interesting speculation as to possibilities of future recovery

◆

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WHEN about two years ago a number of quiescent volcanoes in south-central Chile suddenly burst into activity, ashes fell in such quantities that it was feared that a large part of the country would soon be smothered under a mantle of dust and cinders. Fortunately, the outbreak soon subsided, and, except for a limited sector near the newly active volcanoes, no appreciable damage was done. Clouds of ashes were indeed carried for great distances, and some precipitation of the fine dust was reported from as far away as the east coast of South America in Uruguay and Brazil. In the city of Santiago, about 200 miles north of the active zone, a thin film of impalpable powder was deposited which quickly disappeared under the action of wind and rain.

This outburst was a small-scale geological demonstration of the manner in which much of the terrain of the central longitudinal valley of Chile had been formed. The valley lies between the high range of the Andes to the east and the low Coast Range bordering the Pacific on the west. The greater part of the cultivated land of Chile lies in this valley. It consists of relatively flat tracts of land interspersed with high hills jutting out above the level like islands. In places the foothills of the Andes approach to within a few hundred meters of those of the Coast Range, and the valley narrows correspondingly, though, as a rule, it is several kilometers wide.

In the part of the valley just west of Santiago, the rock material underlying the surface is a weakly consolidated volcanic ash. In the lowest areas it is covered with a few feet of soil or of river gravel, but over a large part the ash is exposed at the surface. Except for some low undulations it does not extend up above the general level of the valley, and the high hills jutting out above this level are entirely free of this material. Its lithologic character is that of a partly consolidated aggregate made up of a sand of comminuted pumice stone with an admixture of foreign material consisting of heterogeneous hillside wash and gravel. A great part, however, is over 99 per cent pumice sand. This rock, if such it can be called, disintegrates upon exposure to the air. It is exceedingly light, the specific gravity of the whole rock mass probably not exceeding 1.5; the larger constituent grains and residual pieces of pumice will float.

The physiography of the region taken in connection with the character of the rock material plainly suggests a former lake or basin which was filled with volcanic ash, probably during a single eruption or a number of closely succeeding eruptions. More than likely, it was a former drainage basin temporarily blocked up in its narrower places by volcanic débris. The purity of the pumice sand rock, mingled with only a small percentage of foreign matter, proves that the ash was collected in the basin in the space of a short time, before any considerable admixture of extraneous erosion products could take place, and one can indeed readily understand that such light material could quickly be washed from a vast area of mountainous territory and collected at lower levels at any place where the drainage might be temporarily obstructed. The rains of a few seasons would suffice to wash off even a thick coating from the hillsides. Furthermore, this occurred within recent geologic time, as erosion has not progressed far enough to alter the aspect of a filled basin that the valley presents. There are, it is true, many long, low ridges or undulations which may have been original bars or dunes formed in the lake, but which may also be the first records of erosion of the lake bed. These ridges (not to be confused with the high hills of solid rock formations jutting out above the basin level) have an elevation of not exceeding 20 meters above the average level of the valley and are composed entirely of the volcanic-ash aggregate. The depth of this aggregate to the former floor of the valley cannot be estimated offhand, but in places it might well reach 50 meters or more.

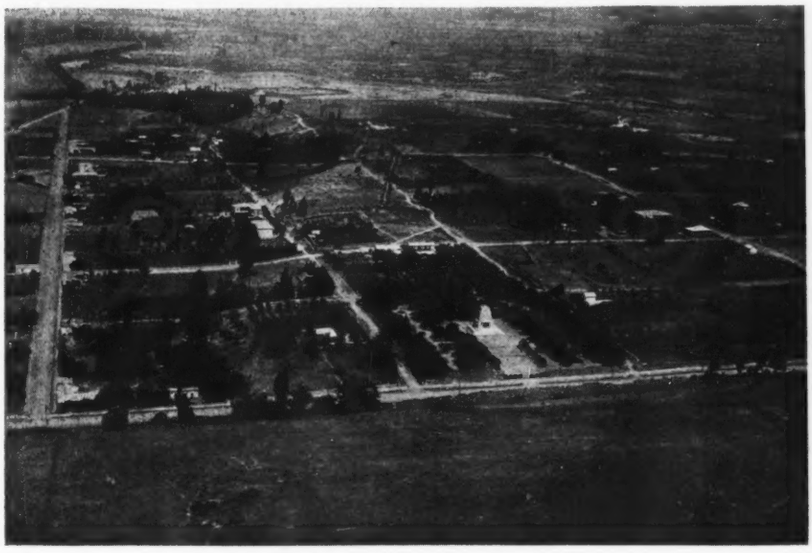
The foregoing details would be of no particular interest except for the fact that several years ago some one with an inquiring turn of mind had some of this sand assayed for gold. Much to his surprise, the returns showed in the neighborhood of a gram of gold per metric ton. Further samples were sent to be assayed, and then again some more. The usual result was a trace; some were entirely blank; but, on the other hand, a number of the samples did assay a few tenths of a gram per metric ton. The customary crucible charge for gold of local assayers was 25 grams of the pulp.

Others took samples and different assayers were tried, now using 50 grams of the pulp. Fewer blanks were reported, and a number of the samples gave from 0.3 to 0.8 grams and a few from 1 to 5 grams per metric ton. I took a number of samples myself, and the best I could get was 0.2 gram, but I did get several assaying between 0.1 and 0.2 gram. I used 500 grams of the pulp of each sample, divided into ten crucible charges of 50 grams each, cupelling the buttons together to form a single bead. Naturally, with material of such extremely low grade, the purity of the reagents used is an important factor, but, on the other hand, blanks or zero results should not occur if there was a trace of gold in the reagents. The sand had frequently been panned, but no colors had been found. However, concentrates obtained by panning invariably gave higher results than the original sand. No pyrite or other sulphides were ever found.

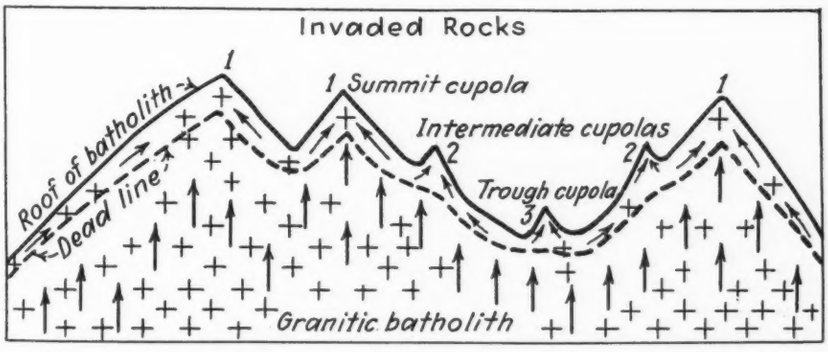
To satisfy myself with regard to the possibility that the source of the gold was in the reagents, I took fourteen samples from various exposures scattered over a length of 80 km. (50 miles) along the valley. These were ground to 60 mesh, and 250 grams of each was panned with extreme care and finished with the horn spoon. Exceedingly tiny specks of gold, visible only with a lens, were now found in nearly all of the samples. Two thousand grams of the pulp of each sample was then taken, panned down to 50 grams more or less, and all of this concentrate used as a crucible charge. There were now no zero results. All of the samples gave either 10 or 15 mg. of gold per metric ton; that is, 1 to 1.5c. U. S. per short ton at present gold prices, but I had no means of knowing the amount lost in the overflow from the pans.

No doubt existed as to the occurrence of gold in the volcanic ash, at least over a stretch of 50 miles along the valley. A bare possibility remained that the gold was not a primary constituent of the ash, but rather was alluvial gold associated with the small percentage of heterogeneous hillside débris washed down and mingled with the volcanic material. To eliminate this possibility a trial on absolutely pure volcanic material was necessary. As occasional fragments of pumice, not yet disintegrated, can be found in the aggregate, some of the larger pieces were picked out, thoroughly cleaned, crushed to 60 mesh, panned and assayed as described in the foregoing. Tiny specks of gold were found in the horn spoon, and the fire assay of the concentrate, calculated back to the original, gave 15 mg. of gold per metric ton exclusive of the loss in panning. Thus there seems to be no escape from the conclusion that gold does occur as a primary constituent of the volcanic ash, but the results so far obtained must be considered as qualitative rather than quantitative. To obtain reliable quantitative data, more refined methods must be used and upon larger quantities of the material than has yet been done. With regard to the possible tonnage, whether the Santiago basin has only one billion tons or ten billion tons is of no immediate interest; the economic aspects must be studied from another angle, as will be seen after a consideration of the problem of genesis.

In seeking a rational explanation for the presence of primary gold in the pumiceous ash, the geologic conception set forth by W. H. Emmons in his paper, "Prospecting for Gold in the Shield Areas of Canada, Siberia, Southern Rhodesia and Western Australia," published in the *Transactions* A.I.M.E., Vol. 102, 1932, offers perhaps the most promising lead. Emmons, as a result of statistical studies of a great number of mineralized batholiths, mostly granitic, believes that mineral-bearing fluids expressed from the cooling igneous mass rise upward under the undulating roof of the batholith. He conceives of a zone, 1 to 3 miles thick, in which the granitic magma is more heavily charged



Maipu, a suburb of Santiago, Chile. All of this section is underlain by the ash aggregate.



Cross-section of ideal granitic batholith, showing (1) summit cupolas, (2) intermediate cupolas, (3) and trough cupolas. Trans. A.I.M.E. Vol. 102

Metallizing solutions press upward from deeper parts of the batholith and converge around cupolas where a large part of the ores are deposited. Except near the roof the granite itself is barren. Valuable deposits are rarely found in the batholith at a greater distance than about three miles or a little more from contact, in high regions of roof, and about one mile from low regions of roof.

with the expressed mineralizing fluids and that except near the roof of the batholith the granite itself is essentially barren. The accompanying drawing, which is a copy of one appearing in the paper by Emmons, clearly illustrates the idea. The upward bulges, "cupolas" of the batholith, are favored positions, as they act in the nature of traps for the more fluid and volatile part of the surcharged magma. Should the invaded rocks overlying such accumulations in the bulges present means of escape in the nature of fractures, the conditions for the formation of lodes would be eminently favorable. Emmons presents maps of many of the world's most important gold-bearing districts, where erosion has progressed to a stage that permits of the study of the relationship of the lodes to the parent batholith, and he has indeed made out a strong case in support of his theory.

Admissibility of this theory to interpret the presence of gold in volcanic ash is apparent when one considers that every volcano has an ultimate mobile connection with, and is an escape valve of, an underlying batholith. More than likely it corresponds in position to an upward bulge, "cupola," if not in fact to a main dome. If the particular batholith in question is mineral-bearing, the zone next to its roof should be more so, as was clearly brought out by Emmons in showing the relative barrenness of mineralized batholiths except in a narrow zone near the roof. Manifestly, this narrow mineralized zone of surcharged magma would first be tapped by a volcano. In other words, a volcano during an outburst wastes the mother-liquor from which veins are crystallized and which may represent the expressed metal content of an enormous volume of batholithic magma. Obviously, this surcharged zone near the roof of the batholith is an intermediate product between the normal granite magma on the one hand and the quartz veins which represent the ultimate product of differentiation on the other. Its metallic grade would necessarily be much lower than the latter. Other conditions being equal, an eruption of gaseously atomized particles of acid ash not accompanied by an effusion of lava should be higher in metallic content, as in that case the volcano taps only the supernatant residuum. On the other hand, the relatively small quantity of ash ejected during a minor eruption would soon be lost and dissipated, leaving no accumulation as a record.

With regard to the Chilean deposit near Santiago, my own samples and assays do not give me any hope of an average grade of more than 0.1 gram per metric ton, and perhaps less. I must admit, however, that others have obtained higher values in gold, on the strength of which some 25 square miles of mining claims have been located. The locations do not cover the entire area underlain by the ash, but only the low hills or dunes which rise above the general level, as these may be more easily worked. A small plant is even now being erected with a few tables and flotation cells.

The pathetic futility of such small-scale operations, involving the handling and treatment of extremely low-grade material in small batches, should be obvious. This partially consolidated aggregate of sandy ash could no doubt be handled cheaply by steam shovel or dredge, but the chance of recovering by gravity methods gold so fine that only by exceedingly careful panning can it be seen at all, does not seem to offer an attractive venture. A more promising line of attack, even though unorthodox, would be to study the possibility of leaching the deposit in place by some

(Continued on page 400)

Ore Reserves and Economic Planning

Sources of Metal Influence Productive Capacity

H. D. Keiser
Associate Editor

PRECEDING articles in this series have covered part of the basic study necessary in order to evaluate the principal non-ferrous metal industries from the standpoint of social importance and to indicate the part played by them in our national development. Additional data are presented here.

During the years 1922-1932 total dividends paid by the copper industry were $448,645,319. Gross value of the output was $2,150,313,779. For lead and zinc, the corresponding figures were: Dividends: lead, $147,026,216; zinc, $253,734,183. Gross value of output: lead, $954,071,603; zinc, $664,513,272. Total dividends for the non-ferrous metal industries during the period were therefore $849,405,718, and gross value was $3,759,898,654.

In studies of the type under consideration, the question immediately arises as to what would have been the industrial development of the United States had it not possessed within its political confines mineral resources from which it could draw, thus re-cycling within the country the money required for their production. In other words, extreme doubt exists that the United States would have purchased the amount of metal indicated by the figures presented in the paragraph had not the sources of this metal been confined to this country.

Even a short, non-inclusive list of the total dividends paid by the non-ferrous metal companies from the time of their inception indicates how relatively small a part of the entire productive record the eleven-year period is. For instance, among the copper companies, total dividends paid to the end of 1932 by American Metal were $16,670,559; by American Smelting & Refining, $201,929,157; Anaconda Copper, $315,566,557; Andes Copper, $16,750,335; Cerro de Pasco, $50,238,256; Chile Copper, $106,180,778; International Nickel, $146,983,013; Kennecott, $244,566,930; Magma Copper, $10,632,306; Mohawk, $15,204,750; Nevada Consolidated, $84,916,109; Phelps Dodge, $130,575,167; United States Smelting, Refining & Mining, $70,860,621; United Verde Extension, $41,763,750; Utah Copper, $228,455,047.

Among the lead and zinc companies, total dividends paid to the end of 1932 by Bunker Hill & Sullivan were $48,506,125; by Eagle-Picher Lead, $2,602,158; Granby Consolidated, $18,310,865; National Lead, $97,596,456; New Jersey Zinc, $45,604,146; St. Joseph Lead, $68,322,835.

In Table I, prepared by Arthur Notman, is shown the year and market value of securities of the principal copper-producing companies, as well as the yield based on interest and dividend payments for 1920-1932. This table is particularly interesting from a purely psychological standpoint, in that it shows the return paid by the copper industry during the period under review.

If, as has been assumed, economic planning is to be part of the future policy of the United States not only is the cost of production of industrial companies important, but their life expectancy is equally so. In the instance of mining, which is ephemeral at best, the question of continuity of operations assumes outstanding importance. In this connection, Tables II, III, and IV are presented to show the reserves of some of the companies already mentioned.

This is the fifth article in a series devoted to a study of production costs, consisting largely of tables prepared by the Minerals Division of the United States Bureau of Foreign and Domestic Commerce.

Table II—Reserves of Some of the World's Principal Copper Mines (*a*)

Country and Company	Year	1,000's of Tons	Grade, per Cent	Copper Content, 1,000's of Tons
UNITED STATES				
Utah Copper	1929	640,000	1.07	6,848
Nevada Consolidated	1929	300,000	1.40	4,200
Phelps Dodge:				
Burro Mountain	1930	11,725	1.95	229
Morenci	1930	245,000	1.10	2,695
Copper Queen	1930	20,675	1.90	393
New Cornelia	....	113,250	1.30	1,472
Inspiration	1925	96,011	1.40	1,344
Miami	1929	97,392	0.95	925
Consolidated Coppermines	1929	32,000	1.10	652
Bagdad	....	48,000	1.20	576
United Verde Extension	1929	625	7.50	47
CANADA				
International Nickel	1930	(*b*) 206,705	(*b*) 4.93	(*b*) 10,190
Hudson Bay	1929	18,000	1.71	308
Noranda	1930	3,426	7.53	258
	1930	3,000	2.00	60
	....	238	1.00	2
Granby	1929	14,342	1.81	260
Sheritt Gordon	....	5,254	2.50	131
Britannia	....	10,000	1.30	130
Amulet	....	527	3.00	16
MEXICO				
Phelps Dodge	1930	3,500	2.70	94
NICARAGUA				
Tonopah Nicaragua	....	1,500	5.00	75
CUBA				
Matahambre	1929	965	5.00	48
CHILE				
Chile Copper	1921	684,000	2.12	14,500
	....	316,000	4.00	12,640
Braden	1929	234,798	2.18	5,118
Andes	1924	137,400	1.51	2,075
AFRICA				
Belgian Congo				
Katanga	1928	85,979	6.41	5,511
Transvaal				
Messina	1929	1,155	3.04	35
Uganda				
Kilembe (Tanganyika Concession)	....	330	4.50	15
Rhodesia				
Bwana M'Kubwa (N'Kana)	1929	200,000	4.00	8,000
Roan Antelope	1929	100,000	3.43	3,430
Mufulira (Rhodesian Selection Trust)	1929	60,000	4.50	2,700
N'Changa	1929	64,641	3.90	2,521
Chambishi (Rhodesian Selection Trust)	....	25,000	3.80	950
Baluba (Rhodesian Selection Trust)	....	25,000	3.20	800
Rhodesian Congo Border Concession	....	60,000	8.00	4,800
Kanshanshi	....	8,000	4.15	332
SPAIN				
Huelva, Rio Tinto (porphyritic)	....	5,000	1.40	70
INDIA				
Indian Copper	1928	756	3.78	29
AUSTRALIA				
Mount Lyell	1929	1,807	4.51	82
	....	2,500	2.25	56
	....	500	2.00	10
	....	1,000	1.50	15
	....	5,000	1.00	50
Totals		3,888,500	....	88,542

(*a*) Barbour, P. E.: "World Copper-Ore Reserves." *E. & M. J.*, Vol. 131, No. 4, Feb. 23, 1931, p. 178.
(*b*) *Metal Bulletin* (London), Nov. 17, 1931.

Table I
Financial Statistics for Principal American Copper Mines (*a*)

(*Prepared by* Arthur Notman)

Year	Year End Market Value of Securities (000,000 Omitted) (*b*)	Yield Based on Interest and Dividend Payments, per Cent
1920(*c*)	$700	1.74
1921	913	2.10
1922	876	2.64
1923	959	6.43
1924	1,160	4.74
1925	1,142	5.67
1926	1,140	6.58
1927	1,144	7.12
1928	2,439	3.88
1929(*d*)	3,351	4.76
1929	1,803	8.84
1930	754	11.93
1931	334	9.67
1932(*e*)	222	2.35

(*a*) Companies included are Anaconda, Andes, Chile, Greene, Inspiration, Calumet & Arizona, Phelps Dodge, Kennecott, Nevada, Mother Lode, Calumet & Hecla, Cerro de Pasco, United Verde, United Verde Extension, Granby, Miami, Magma, Mohawk, Old Dominion, Copper Range.
(*b*) The figures for market values have been adjusted for duplications due to ownership of securities by members of the group; that is, other members of the group. All fixed obligations have been valued at par.
(*c*) Lows, (*d*) Highs, (*e*) Dec. 29.

Table III—Reserves of American Zinc-Lead Mines (*d*)

Mine or District	Tons of Ore	Zinc, per Cent	Lead, per Cent	Silver, per Cent	Zinc, Tons	Lead, Tons	Mill Capacity, Tons
APPALACHIAN							
Balmat	8,500,000	11.5	1.0	0	977,500	85,000	165,000
Edwards	500,000	12.5	nil	0	62,500	nil	
Wythe(*a*)	6,000,000	5.5	1.5	0	330,000	90,000	450,000
TRI-STATE DISTRICT(*b*)	150,000,000	4.0	0.8	0	6,000,000	1,200,000	15,000,000
MONTANA-IDAHO							
Block P	500,000	5.5	6.5	10	27,500	32,500	125,000
Butte & Superior	183,000	13.0	1.3	6	23,790	2,379	225,000
Morning	1,653,000	6.0	9.0	4	99,190	148,800	380,000
Star	3,240,000	11.5	5.3	1.4	364,500	172,000	180,000
COLORADO-NEVADA-NEW MEXICO							
Eagle(*a*)	5,000,000	12.5	2.5	?	625,000	125,000	225,000
Sunnyside	650,000	5.0	4.0	4	32,500	26,000	330,000
Panaca	1,000,000	18.5	8.0	7	185,000	80,000	none(*c*)
Pecos	650,000	17.0	5.0	3	110,500	32,500	150,000
Hanover(*b*)	2,000,000	15.0	...	..	300,000	.....	175,000
Tybo	230,000	5.0	6.0	10	11,500	13,800	100,000
Totals	180,106,000				9,149,480	2,007,979	

(*a*) Estimated.
(*b*) Inclusive of all of the mines of this district.
(*c*) Ore milled in Utah.
(*d*) Ingalls, W. R.: "World Survey of the Zinc Industry." *Transactions*, Mining and Metallurgical Society of America, 1931, p. 122.

In the above table Butte & Superior is included, although now exhausted, for purpose of giving an idea of the grade of Butte ore. The chief omission of important mines are Elm Orlu and Orphan Girl mines at Butte; and the Davis mine of Universal Exploration; also all of the mines of Utah.

Table IV—Reserves of American Zinc, Zinc-Copper, and Zinc-Manganese Mines (*b*)

Mine	Tons of Ore	Zinc, per Cent	Lead, per Cent	Silver, per Cent	Zinc, Tons	Lead, Tons	Mill Capacity, Tons
Mascot	6,000,000	3.0	0	0	180,000	nil	850,000
Jarnagin	750,000	3.5	0	0	26,250	nil	
Franklin, Sterling (*a*)	10,000,000	19.0	0	0	1,900,000	nil	925,000
United Verde	12,000,000	7.0	0	2	840,000	nil	none
Totals	28,750,000				2,946,250		

(*a*) Estimated.
(*b*) Ingalls, W. R.: "World Survey of the Zinc Industry." *Transactions*, Mining and Metallurgical Society of America, 1931, p. 122.

Specially Designed Manometer

Simplifies Determination of Percentage Of Solids in Pulp

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THE accompanying illustration shows a manometer that has been designed and calibrated to simplify operating determinations of the percentage of suspended solids in the neutral thickener overflow at the zinc plant of the Hudson Bay Mining & Smelting Company. The method employed involves no measurements of weights of volume quantities.

To make a percentage-solids determination, a sample of the pulp is placed in the sample burette, shown in the drawing, and is then let flow until the kerosene column is forced just beyond the "Index" arrow. This will necessitate a column of the pulp extending into the inclined scale arm for a reading. The drain on the kerosene bottle is used in making the final kerosene-head adjustments, as well as for draining the charge from the apparatus after the reading has been taken. Similarly, the filtrate is run and its reading taken. The difference in the pulp and filtrate readings is the percentage of solids in the pulp. A single scale division represents one-tenth of 1 per cent of solids in the pulp.

Empirical calibration of the scale being a rather laborious task, it was dispensed with in favor of the following simple analytical one:

W = weight of 1 liter of pulp
S = weight of 1 liter of filtrate
w = weight of solids suspended in 1 liter of pulp
d_w = density of pulp
d_s = density of filtrate
d_o = density of solids
h_w = head in inches of pulp
h_s = head in inches of filtrate

$$\text{Then, } W = S + \frac{w}{d_o}(d_o - d_s),$$

from which it follows that

$$\frac{w}{W} = \frac{W - S}{W}\,\frac{d_o}{d_o - d_s};$$

$\frac{w}{W}$ being the percentage-solids factor, we find that $\frac{W - S}{W}\,\frac{d_o}{d_o - d_s} \times 100$ is the percentage of solids.

It is in order of magnitude to have one scale division represent 0.1 per cent of solids in the pulp. We are therefore interested in the particular case where

$$\frac{W - S}{W}\,\frac{d_o}{d_o - d_s} \times 100 = 0.1$$

that is, $\dfrac{d_w - d_s}{d_w}\,\dfrac{d_o}{d_o - d_s} = 0.001$

or $d_o(d_w - d_s) = 0.001\, d_w(d_o - d_s)$

from which it follows that

$$d_s = \frac{0.999\, d_w d_o}{d_o - 0.001\, d_w};$$

$d_o = 4$ in this pulp.

$$\text{hence, } d_s = \frac{3.996\, d_w}{4 - 0.001\, d_w} \qquad \text{Equation 1}$$

From the fundamental principle of the apparatus we have

$$\frac{d_s}{d_w} = \frac{h_w}{h_s}, \text{ from which we get that}$$

$$h_s - h_w = h_s\,\frac{d_w - d_s}{d_w} \qquad \text{Equation 2}$$

The dimensions of the manometer are a function of the accuracy required of it. In the specific model employed, the kerosene is forced to the "index" point by a 50-in. head of solution of density 1.310. When the density of the solution is 1.230, the solution head is necessarily about 53.25 in. Through the active range from 50 to 53.25 in. one arm of the tube in which the solution rises is placed on an incline and carries the scale. This part of the tube is 32.5 in. long, and rises through 3.25 in. This arrangement permits ten times the accuracy in reading the percentage solids in the pulp that could be had on a vertical tube carrying a scale. From these specifications, together with Equations 1 and 2, we obtain Table I, showing the nature and relationship of scale divisions representing 0.1 per cent solids in the pulps of various densities. Thus we find that there are 86 scale divisions in arithmetic progression as in Table II.

Table I

Pulp Density G/c.c. d_w	Computed Filtrate Density for 0.1% Solids G/c.c. d_s	Density Difference for 0.1% Solids G/c.c. $d_w - d_s$	Filtrate Head (From (Apparatus) In. h_s	Scale Division for 0.1% Solids In. D = 10 $(h_s - h_w)$	Relationship between Scale Divisions Increment In. $D_s - D_{s+10}$	Existing Between Scale Divisions Increment Per Division, In ΔD
1.310	1.3091184	0.0008816	50.00	0.3360	.....	.....
1.290	1.2891254	0.0008746	50.78	0.3340	0.0080	0.000376
1.270	1.2691326	0.0008674	51.60	0.3520	0.0080	0.000376
1.250	1.2491400	0.0008600	52.40	0.3600	0.0080	0.000376
1.730	1.2291488	0.0008512	53.25	0.3680	0.0080	0.000376

Apparatus for reading percentage of solids in pulp directly

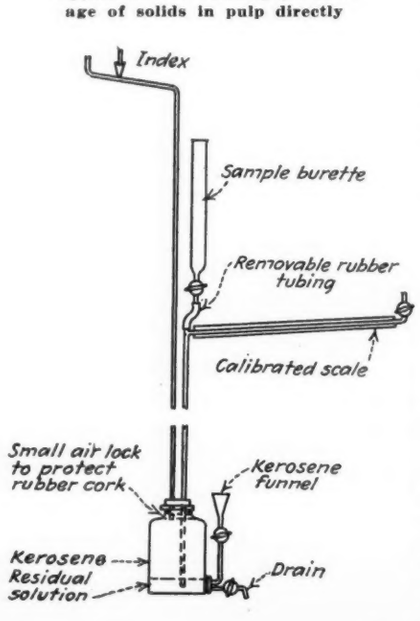


Table II

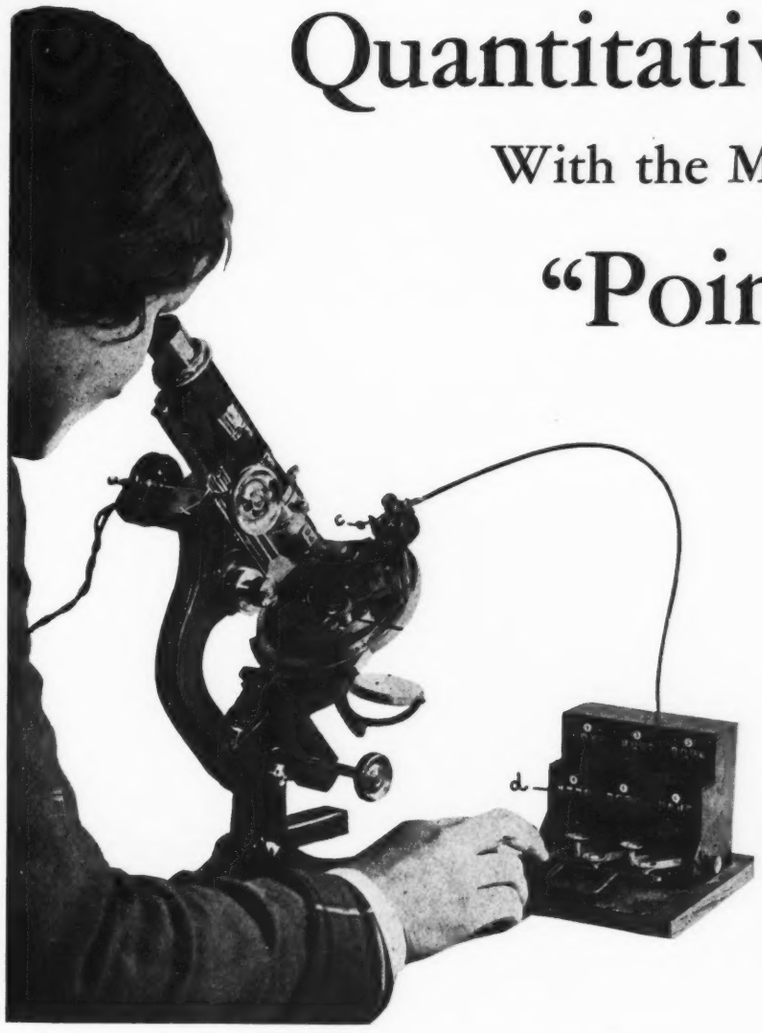
Division	Length in Inches
D_1	0.3360
D_2	0.336376
D_3	0.335752
D_{85}	0.367634
D_{86}	0.3680

By a simple geometrical construction these values can be stepped off graphically. A scale so constructed may then be placed in position on the apparatus. The manometer so calibrated proved satisfactory. The results obtained with the apparatus were found to be correct within 1 per cent of the absolute quantity present, as determined by the usual laboratory methods.

Quantitative Analysis

With the Microscope . . . by the

"Point" Method



With an integrating device developed at the Institute of Economic Mineralogy, in Moscow, the composition of ores, mill products, alloys, and other materials that are discernible with or without etching can be quickly ascertained

◆

A. A. Glagolev

Petrographic Laboratory
Institute of Economic Mineralogy,
Moscow, U. S. S. R.

Fig. 1—Microscope with integrator for analysis of specimens having as many as six components

RAPID and convenient analysis of minerals, ores, concentration products, alloys, and many other materials has been made possible by the use of a new type of apparatus which I designed and developed at the petrographic laboratory of the Institute of Economic Mineralogy, in Moscow. A requisite in the use of the apparatus is that the constituents of the material to be analyzed must be present in forms discernible by the microscope, either directly or after preparatory treatment by etching or staining. The analysis is performed by the new "point" method described in Vol. 59 of the Institute's *Transactions*, a brief outline of which will be presented in the following.

A large number of points are distributed uniformly over a thin section prepared from the material to be analyzed, and the number of points falling on each constituent is then determined by a rapid method of counting. The probable error in this method is governed by the number of points taken and is expressed by the formula $\delta = 0.67\sqrt{\frac{A(100-A)}{n}}$, where δ is the probable error of determination, n the total number of points taken, and A the percentage of the constituent contained in the material. With 50 per cent of the component and 1,000 points, for example, the probable error would be about 1 per cent.

The distribution of points and the actual counting are easily accomplished by the integrating apparatus shown in Fig. 1. The prepared specimen is placed on a specially constructed mechanical stage in the microscope, and the operator focuses the cross-hair at the extreme end of the section; then he presses the key selected for the component which appears at this point, registering one count on the recording meter (*d*, Fig. 1). With the pressing of the key the section is automatically shifted a definite distance, determined by the adjustment screw *c*, and a new observation is made and recorded by pressing the key. After completion of one line of the specimen another line is taken up in the same manner until the entire section has been examined. The distribution of the points, which is governed by the nature of the material at hand and the accuracy demanded, is illustrated in Fig. 2.

The method is quite rapid. Analysis of a section with 1,000 to 1,500 points does not require more than 20 to 30 min. The apparatus shown in Fig. 1 is designed for simultaneous determination of six components. This number may, however, be increased if necessary. Among the valuable features of the apparatus may be mentioned the following: The recorder is separated from the microscope stage itself, thereby relieving this from any excessive load; the stage of the microscope may be revolved in any direction during the determination, which is sometimes necessary for proper diagnosis of the specimen; the points recorded are taken in two directions along a series of parallel lines, a procedure which eliminates any loss of time in bringing the slide back to its original position; by the aid of a device on the micrometer screw it is possible to pass from one line of observation back to another without looking at the scale of the mechanical stage; and the operator may give his undivided attention to the specimen, thus avoiding interruptions in the routine of the analysis. The last feature is of particular importance, and the entire

Table I—Concentrate From Sulphide Ore

Mineral	Per Cent by Weight	Calculated Composition, per Cent Cu	Fe	S	SiO_2
Chalcopyrite	33.6	11.6	10.2	11.8	.....
Chalcocite	23.4	18.7	....	4.7	.....
Tetrahedrite	1.3	0.6	....	0.4	.....
Pyrite	12.5	....	5.8	6.7	.....
Quartz	15.0	....	....	....	15.0
Sericite	14.0	....	....	....	6.4
Totals	100.0	30.9	16.0	23.6	21.4
Chemical analysis	....	29.12	15.97	26.63	20.18

Table II—Concentrate From Oxidized Ore

Mineral	Per Cent by Weight	Calculated Composition, per Cent Cu	Fe	S	Al_2O_3	SiO_2	CO_2	H_2O
Chalcopyrite	0.5	0.17	0.15	0.18	....	.....	....	....
Chalcocite	1.65	1.32	....	0.33	....	.....	....	....
Covellite	0.2	0.13	....	0.07	....	.....	....	....
Pyrite	0.6	.....	0.28	0.32	....	.....	....	....
Malachite	18.1	10.39	....	....	....	.....	3.60	1.48
Azurite	3.9	2.16	....	....	....	.....	1.00	0.20
Limonite	1.3	.....	0.78	....	....	.....	....	0.19
Quartz	52.4	.....	....	....	.....	52.40	....	....
Sericite	21.4	.....	....	....	5.98	9.97	....	....
Totals	100.05	14.17	1.21	0.90	5.98	62.37	4.60	1.87
Chemical analysis	....	14.28	1.51	0.81	6.81	60.24	7.83	

design of the apparatus is made with this objective in view, to insure speed and ease of operation.

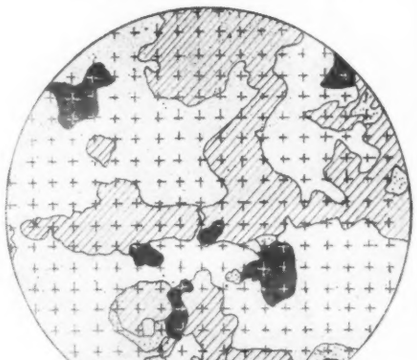
A systematic quantitative mineralogical investigation of ore deposits such as made possible by the apparatus described should be of great interest to geologists, mining engineers, and metallurgists. Detailed data on mineralization, oxidation, leaching, and cementation of orebodies may readily be obtained with comparatively small effort and expense. An illustration of the possibility of the method is given in Fig. 3, in which is presented a mineralogical assay of one of the boreholes at the recently opened copper deposit at Kounrad, Kasakstan. The striking similarity between the unbroken curves, representing the mineralogical analyses, and the dotted curves, representing the actual chemical analyses, testifies clearly to the reliability of the method. Such data on the drill holes of a deposit should be a valuable aid in the selection of mining methods and in the design of concentration and reduction plants, as the chemical analysis of the principal metals does not alone give a complete picture of the deposit.

Practical results at the laboratories of the Institute of Economic Mineralogy as well as at the experimental concentration plant at Kasakstan have shown definitely that a complete mineralogical analysis, including the preparation of the specimen, requires only about one hour. In Tables I and II are presented the analyses of the concentrates obtained in the treatment of a sulphide ore and an oxidized ore, respectively, with calculation of the compostion from the data obtained. The results of a regular chemical analysis presented for comparison show a remarkably close agreement with the calculated figures. The apparatus has also been used with success at a number of other scientific institutions throughout the Soviet Union.

(Continued from p. 396)

solvent such as a weak chlorine solution. The sandy aggregate, already somewhat permeable, could be rendered much more so by loosening up with explosives. Large areas could be simultaneously attacked from many points; capital investment would be relatively low; slow percolation, but over tonnages so enormous that the time factor is neutralized.

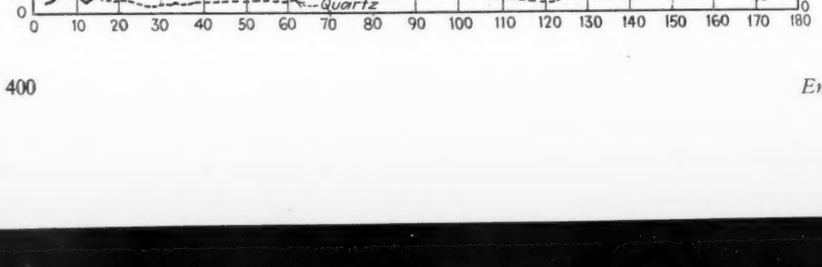
Fig. 2—Graphic presentation of the distribution of the points



My object is not to dwell upon the details of the Chilean deposit except in so far as a consideration of some of the outstanding points might help in visualizing the broader implications of the problem it presents. If the hypothesis advanced to explain the genesis of the gold in this deposit is correct, then it cannot be unique and there must be many similar deposits in all parts of the world. It is probably neither the best nor the worst of the lot. In some other deposits the ash may have higher values in gold; the gold may be coarser; there may have been classification during settling of the ash and as a consequence, enriched zones. In fact the range of possibilities is wide, but, first of all, the validity of the hypothesis itself must be tested and the first obvious question to present itself is: has gold ever been found by ony one in volcanic-ash deposits in other parts of the world? In this connection it may be mentioned that about 25 years ago, J. B. Hastings, in *Trans.* A.I.M.E. Vol. 39, 1909, p. 97, describes a lake-bed deposit in Colorado of some 400,000,000 tons averaging 20c. gold per ton, which, according to the description, closely resembles in many respects the volcanic-ash deposit in Chile. As no doubt pumiceous volcanic ash occurs at the very doorstep of many of the readers of this article, any communications through the *Engineering and Mining Journal,* providing data either to prove or disprove the premise here discussed, might be of real interest to the mining community.

Considered in its larger aspects, some regions of vulcanism should be more favorable than others. The combination of volcanic and topographic circumstances to which the Santiago deposit owes its existence has, no doubt, been paralleled a number of times on the flanks of the long range of the Andes, with its numerous extinct, dormant, and active volcanoes. There are probably many other deposits in Chile itself, and in other Andean countries, as good as or better than the one described. We may not reasonably assume that the vents through which the ash of this deposit reached the surface tapped the batholith in its most favorable spot, nor that this particular batholith or portion of batholith is heavily mineralized, for there are no really important gold mines in this part of Chile. Taking a world view, many places are doubtless to be found where the basic conditions are more favorable, especially with respect to the mineral antecedents of the batholith. Tertiary or recent batholiths which can show a progeny of gold veins present the most promising field for investigation. More ancient batholiths, even though they may have been productive of gold veins, are not as interesting, inasmuch as ashes thrown out by the latter could probably now be found only as beds of indurated tuffs.

Fig. 3—Analysis of borehole showing the change in mineralization with depth



Katanga Ores

Offer a Variety of Treatment Problems

Many Different Copper Minerals Normally Occur

Results of Tests Made Upon Them to Determine Their Amenability to Flotation Are Presented by the Author

R. E. Barthelemy

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MR. BARTHELEMY *was formerly consulting engineer in ore-dressing work for the Union Minière du Haut-Katanga. Some months ago, while en route to French Indo-China, where he is now assistant manager for the Société d'Etudes et de l'Indochine, he again visited the Katanga properties, the notes on which this article is based resulting*

SOME knotty milling problems are presented by the different ores occurring on the properties of Union Minière du Haut-Katanga, in the Belgian Congo. The deposits fall into three different groups:

1. Elisabethville group — Ruashi (oxides and sulphides), Star of Congo, Lukuni (oxides), and Prince Leopold (mixed copper-zinc sulphides) mines.

2. Jadotville group—Kambove, Changolowe, Luishia, and Likasi mines—all oxide.

3. Western mines group, including Kolwezi mine, a large copper oxide zone, not yet opened.

Milling Oxide Ores

The largest mine working oxide copper ores is the Kambove. The ore is sent to the Panda concentrator, 10 miles away. This plant has three different sections:

1. Grinding and picking section, having a capacity of 4,500 tons in one shift, normally running during the day. Mine ore is dumped into concrete bins of 6,500 tons' capacity. Coarse grinding is done in four suspended spindle-type gyratories followed by Blake-type jaw crushers and rolls. Sizing is controlled with trommels. The ore is then sorted by hand on picking belts, the coarse concentrate (averaging 36 per cent copper) being directly dropped into cars for shipment. The remaining ore goes to concentration.

2. Gravity concentration section. Here the ore is distributed with a tripper to bins having 10,000 tons' total capacity. Sizing is then effected with trommels, shaking screens, and Hummer vibrating screens (for the fine products only). Coarse sizes are treated in Hancock jigs and ordinary jigs. The fine sizes and the middlings, reground in Hardinge mills, are fed, after hydroclassification, to Wilfley tables. The wet concentrates produced are stored in bins, having filter bottoms, from which they are loaded into cars and shipped to the smelter. Tailings go to flotation.

3. Flotation section. From the technical viewpoint this section is the most interesting part of the milling of the Katanga oxide ores.

Flotation gives good recovery on the carbonate, malachite. Practically none of the silicate, chrysocolla, is as yet recovered.

Malachite in the tailings of the gravity section (1) is floated, after secondary grinding in 10-ft. Hardinge mills working in closed circuit with large Dorr classifiers. The pulp, from three Dorr tray thickeners (50 ft. in diameter, 25 ft. high), thickened to 20 per cent solids, is conditioned with 2.4 lb. sodium carbonate and 1.5 lb. sodium silicate in agitator tanks, where, heated by vapor circulation, it is maintained at 95 deg. F. This pulp is then fed, with 4.2 lb. of special frothing collecting mixture, to eight sections of 24-in. Minerals Separation Sub A positive-flow flotation machines, having cleaning, double recleaning, and scavenging circuits. The special mixture is made of six parts, by volume, of hydrolyzed (50 per cent acidity) palm oil and one part oleic acid. Testings have proved that twelve parts of corn oil instead of hydrolyzed palm oil give better results. The concentrates average 35 per cent copper and are pumped to the filter plant situated at the Panda smelter. Rejected tailings contain about 1.7 per cent copper. Metallurgical results are given in Table I, which appears on the following page.

New Process Devised

As can be seen in Table I, the copper is recovered largely by flotation, which is the greatest improvement made in the concentration of copper oxide minerals in recent years. In 1933, we succeeded in devising a new process, using our special reagent No. 0.7 in combination with high-alcoholic xanthates in economical amount, which is able to lower the flotation tailing under 1 per cent copper and increase the grade of concentrates to over 40 per cent, bringing the recovery by flotation above 92 per cent. This process, when in use, will not only be able to improve the copper recovery but will also cut down the cost of treatment considerably.

The Prince Leopold mine, situated close to the Rhodesian border, is practically the only property of the company that is working sulphide ores. To date, the ore has not been concentrated save for a very inefficient picking. It is shipped directly to the Lubumbashi smelter, near Elisabethville, 20 miles away.

Only high-grade ores are mined and shipped as direct smelting. The vein is more than 70 ft. wide and almost completely mineralized with complex copper-zinc sulphide, having very little gangue material. The primary minerals are sphalerite and chalcopyrite; the secondary are chalcocite and bornite, as well as the minerals of normal oxidation above the water table, which is about 240 ft. below the surface.

At present, the mine can be divided into three zones:

1. A zone of zinc-free, argillaceous copper ore, containing about 2 per cent

copper. It has never been mined, being considered too low in grade.

2. A copper-zinc sulphide zone, where selective mining is now performed to get only massive direct-smelting ores, containing more than 17 per cent copper, leaving all lower-grade ore in the stopes and filling.

3. A massive copper-free zone, highly mineralized in zinc, out of consideration for mining. Although a high-grade copper mine, Prince Leopold contains much more zinc than copper, according to the tonnages proved of the respective metals. Table II shows the average analysis of the two kinds of copper ore.

Thus far, only a small amount of arsenic has been found, the mineral carrying it being regnolite. But, indicated by drilling, a decided increase in the arsenic is to be expected at greater depth (cores sometimes show as high as 4 per cent arsenic), as well as less copper and more zinc. In the future, the problem of separation of tennantite, the arsenic-bearing mineral at depth, from the other valuable copper minerals will be one of the most important. At present, the mine is worked at the 400-ft. level.

Owing to the decrease in the copper content of the ore, Union Minière became interested in the concentration of these copper-zinc sulphides. For this reason, I was asked in 1930 to investigate the various problems involved, in order to obtain data as a basis for designing a concentrator.

The first real advance was made when it became possible to apply to the treatment of these copper-zinc sulphides a new differential flotation process in which the zinc was floated first, thereby making easy the subsequent concentration of the different copper sulphides. This process was described in the July, 1933, issue of *Engineering and Mining Journal*, p. 280, for which reason I will set down only certain results of its application to these ores. This is done in Table III.

Table I—Monthly Metallurgical Results, Flotation Section, Panda Concentrator

Tons treated	60,315
Copper, per cent	11.80
Tons picked concentrates	121
Copper, per cent	37.40
Tons gravity concentrates	7,799
Copper, per cent	35.10
Recovery by picking and gravity treatment, per cent	39.07
Tons flotation feed	52,395
Copper, per cent	8.28
Tons flotation concentrates	10,498
Copper, per cent	35.33
Flotation tailings, copper, per cent	1.50
Recovery by flotation, per cent	85.50
Over-all ratio of concentration	3.28:1
Over-all recovery, per cent	91.17

Table II—Analyses of Prince Leopold Ores

	Argillaceous Zinc-Free Copper Ore	Copper-Zinc Sulphides
Cu, total	7.80	12.47
Cu, oxide	1.83	2.17
Zn	0.37	9.86
Pb	Trace	0.65
S	3.46	6.92
SiO_2	43.80	26.96
Al_2O_3	16.74	6.72
FeO	7.29	6.50
MgO	3.54	6.07
CaO	2.50	6.14
Silver, oz.	4.20	9.80

Table III—Application of Barthelemy Differential Flotation Process to Prince Leopold Copper-Zinc Sulphides

	Copper	Zinc	Silver
Heads	12.53	9.45	10.1
Bulk flotation			
Copper-zinc bulk concentrate	27.15	34.35	....
Bulk tailing	8.37	2.30	....
Bulk concentrate treatment			
Zinc flotation concentrate	5.05	58.73	4.1
Tailing (copper concentrate)	49.88	9.30	51.2
Bulk tailing treatment			
Floated copper concentrate	31.53	3.92	20.0
Tailing (general tailing)	1.52	1.82	0.9
Combined results			
Heads	12.53	9.45	10.1
Zinc concentrate	5.05	58.73	4.1
Copper concentrate	38.58	6.00	31.8
General tailing	1.52	1.82	0.9
Copper distribution			
In copper concentrates; recovery per cent	88.11		
In zinc concentrates, per cent	4.61		
In general tailing, per cent	7.28		
Flotation reagents, pounds per ton			
Sodium carbonate, lb.	1.9		
Special conditioning reagent, lb.	0.9		
Sodium Aerofloat (bulk flotation), lb.	0.18		
Potassium ethyl xanthate (bulk tailing flotation), lb.	0.26		
Pine oil, lb.	0.11		

The results in Table III, which were obtained at the 300-ton pilot plant under my supervision, although easily maintained on an industrial scale, are to be had only with careful control of flotation conditions and labor well trained and experienced in differential flotation. The large new flotation plant which is to be started next July at the Prince Leopold will require very good flotation men.

Aside from the complex copper-zinc sulphides, the treatment of the argillaceous copper ore was also investigated and a method decided upon. Pilot-plant treatment gave on this kind of ore the results shown in Table IV. Presence of numerous different copper oxides (malachite, black oxides, ziegelerz), which were partly recovered by tabling owing to their high silver content, is the reason of the poor over-all recovery.

As regards the elimination of arsenic-bearing sulphide by flotation, laboratory tests undertaken on samples showing as high as 2.5 per cent arsenic were encouraging, but the process has not yet been decided upon, more investigation being necessary. It is reasonable to expect that a product containing almost all the arsenic-bearing sulphide (tennantite) can be obtained, leaving in the remaining copper concentrate a very small amount of that metallurgically harmful impurity.

Table V gives the results of a laboratory test made on a sample containing 2.31 per cent arsenic and 8.40 per cent arsenic-free copper. Careful control of the pH is the most important requisite for getting these results.

As can be seen by the problems presented by the concentration of Prince

Union Minière's Panda concentrator

1, Crushing plant; 2, pilot plant; 3, concentrator unit; 4, flotation.

Table IV—Flotation-Tabling Treatment of Prince Leopold Copper Argillaceous Ore

	Cu Total, per Cent	Cu, Sulphide, per Cent	Ag, Oz.
Heads	8.58	6.46	4.54
Flotation concentrates	44.79	43.10	22.3
Flotation tailing	3.46	1.49	.....
Table treatment of flotation tailing			
Table concentrates	28.37	19.61	28.0
Table tailing (general tailing)	2.69	0.90	1.36
Over-all copper concentrates	41.90	39.02	.....
Recovery: Total copper, per cent	.....	73.4	.....
Sulphide copper, per cent	.....	90.6	.....

Reagents, pound per ton	
Lime	6.1
Potassium ethyl xanthate	0.72
Wood creosote	0.03
Pine oil	0.09

Table V—Flotation Test on Separation of Tennantite From Arsenic-Free Copper Sulphides

	Arsenic, per Cent	Copper, per Cent
Products		
Heads	2.31	16.23
Arsenic concentrates	14.24	51.82
Copper concentrates	0.36	27.13
Tailing	0.50	2.63

Average mineralogical composition of the products:

	Tennantite, per Cent	Arsenic-Free Copper, per Cent
Heads	13.58	8.40
Arsenic concentrate	83.70	3.50
Copper concentrate	2.12	25.91
Tailing	2.94	0.94

Tennantite recovery, per cent	83.7
Arsenic-free copper recovery, per cent	87.8
Reagents, pounds per ton	
Sodium hydroxide	1.13
Special conditioner	1.46
Sodium Aerofloat No. 208	0.17
Potassium amyl xanthate	0.14
Eucalyptus oil	0.09

Table VI—Flotation of Carrollite From Cobalt-Free Copper Sulphides

	Cobalt, per Cent	Copper, per Cent
Heads	2.08	5.70
Copper concentrates	1.34	30.33
Cobalt concentrates	16.32	10.42
Tailing	0.68	0.85

Average mineralogical composition of the products:

	Carrollite, per Cent	Cobalt-free Copper, per Cent
Heads	5.04	4.92
Copper concentrate	3.25	29.83
Cobalt concentrate	39.60	4.27
Tailing	1.65	0.60

Cobalt recovery in cobalt concentrate, per cent	70.30
Cobalt-free copper recovery in copper concentrate, per cent	89.40
Reagents, pounds per ton	
CaO	1.2
NaCN (copper circuit)	0.25
$CuSO_4$	0.55
Potassium amyl xanthate	0.82
Pine oil	0.11

Leopold ores, the field here is still open for research.

Underground development was undertaken at the Ruashi mine, which had been shut down after all the oxidized capping had been removed. A shaft was sunk, and at the 150-ft. level a drift was driven in a copper-cobalt mineralized vein, about 23 ft. wide, situated at the contact of "Roches siliceuses feuilletees" and dolomitic limestones. The average copper content of the ore was about 8 per cent, mostly as bornite. Near the dolomitic contact, interesting enrichments in cobalt were found, cobalt being in the form of carrollite, a copper-cobalt sulphide (CuS, Co_2S_3) of the following chemical composition: cobalt, 41.28 per cent; copper, 15.53; iron, 0.45; and sulphur, 42.54 per cent, with only traces of nickel. Results of laboratory tests on the differential flotation of this ore are given in Table VI.

Presence of extensive talcous zones, resulting from metamorphic alteration of dolomitic rocks, is the cause of grave difficulties experienced in the treatment of the ore by flotation, including the lowering of the grade of concentrates and the increasing of their insoluble content. That difficulty was finally overcome by floating the talcous product before the copper flotation, a method generally followed in the United States when such trouble is met.

Talc flotation was effected in a neutral circuit with a small amount of frother only (0.03 lb. pine oil). Copper was then floated with lime (0.9 lb.), potassium ethyl xanthate (0.45 lb.), and a small increase in pine oil (0.07 lb.). Recovery of the copper was about 92 per cent in a 41 per cent concentrate, with less than 3 per cent insoluble. Without floating the talc first, the concentrates were as low as 25 per cent copper with more than 18 per cent insoluble.

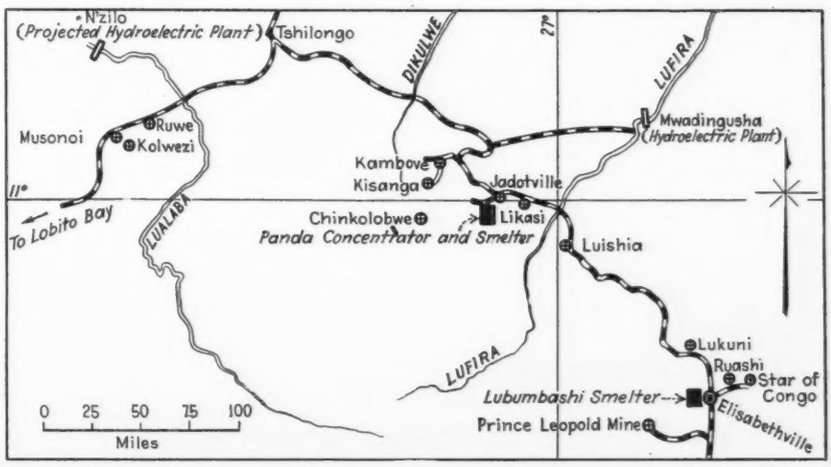
In the Chinkolobwe mine, the largest radium mine in the world, a crosscut intersected a 6-ft. vein mineralized with

Table VII—Flotation Test on Chinkolobwe Linneite

Heads: per cent cobalt plus nickel	2.22
Concentrates: per cent cobalt plus nickel	26.27
per cent sulphur	39.52
Tailing: per cent cobalt plus nickel	0.18
Recovery, cobalt plus nickel, per cent	92.5
Reagents: pounds per ton	
Sodium carbonate	0.80
Potassium ethyl xanthate	0.51
Yarmor pine oil	0.08

Table VIII—Copper Minerals Occurring In Katanga Deposits

	Composition	Specific Gravity	Color
Oxide minerals			
Malachite	$(CuOH)_2CO_3$	3.75	Green
Chrysocolla	Cu silicate with hydrated silica	2.10	Green or blue
Cuprite	Cu_2O	5.95	Glassy Red
Cornetite	Hydrated copper phosphate	....	Blue green
Katangite	Hydrated chrysocolla	....	White blue
Plancheite	Hydrated copper silicate and phosphate	....	White green
Shattuckite			
Tenorite	CuO	6.00	Black
Libethenite	Cu (CuOH) PO_4	3.70	Green olive
Cuprodescloisite	(Pb, Cu, Zn) (PbOH) VO_4	6.10	Green olive to black
Kipushite	Cu-Zn phosphate (found only in Prince Leopold and Kipushi mines)	....	.....
Sulphide minerals			
Chalcopyrite	$CuFeS_2$	4.20	Golden yellow
Bornite	Cu_5FeS_4	5.10	Violet
Chalcosine	Cu_2S	5.80	Black
Tennantite	$Cu_3As_2S_7$	4.40	Greasy dark gray
Carrollite	Co_2CuS_4	4.80	Silvery
Linneite	(Ni, Co) CuS_4	4.85	Silvery yellow



Principal points of interest in the territory controlled by Union Minière du Haut-Katanga

linneite (cobalt-nickel sulphide), of practically no economic value. Samples taken were, nevertheless, tested by flotation, and results are shown in Table VII. The ore is a dolomitic giobertite carrying 2.2 per cent of cobalt and nickel, the two metals being about equal in amount. This was easy to concentrate, giving a brass-yellow and silver-colored foam.

The foregoing may serve to give the reader a glance over the most highly mineralized zone and one of the richest mining camps in the world. Table VIII will afford an idea of the many different kinds of copper minerals normally occurring in the Katanga properties.

I take this opportunity to thank all the anonymous collaborators met in Katanga during my stay there, and particularly my friend Dr. G. Gutzeit, now professor at Geneva University, in Switzerland, whose experience was of great help to me in my investigations which made possible this report on the Katanga ores.

Mining Lode Gold In Piedmont Virginia

Rapidan Corporation Developing Two Formerly Active Properties

C. S. Anderson

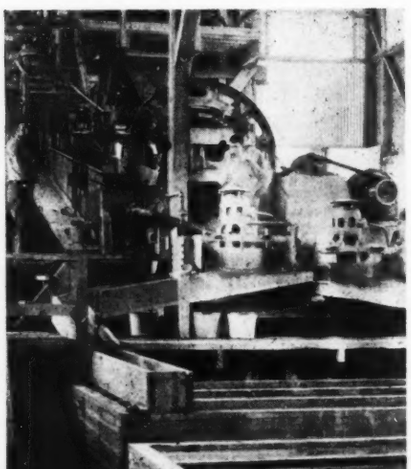
Mill Superintendent
Rapidan Gold Corporation
Fredericksburg, Va.

RENEWED activity in the old gold-mining districts of the Southern Appalachians has been caused by the current high price of gold. Of particular interest are the operations of the Rapidan Gold Corporation at its Melville and Vaucluse mines, in Northeastern Piedmont Virginia, County of Orange, and approximately 18 miles from Fredericksburg. These properties had a long history of activity before the Civil War, and the extent of old workings, shafts, and open cuts, traceable on the surface for 6,000 ft., indicates that they probably accounted for a large part of the $3,298,542 credited to Virginia gold mines by United States Government statistics.

An old shaft at the Melville was first reopened, and subsequently, in 1933, a new working shaft was sunk. It is bottomed at 220 ft., with laterals at this and at the 112-ft. level. A camp, power house, and 100-ton mill were built. Production began in May, 1934, with ore taken out in development work now paying a large share of direct operating costs. At the Vaucluse mine an old shaft is now being reopened, and underground connection, a distance of 2,500 ft., between it and the Melville is projected. The company employs 70 men.

The lode or vein system apparently follows a line of fracture or weakness in the sericite quartz-schist country rock of Pre-Cambrian or Cambrian age. In general it conforms with the strike, northeast-southwest, and steep dip to the east of the schistosity, but, locally underground, quartz is seen to cut across the foliation. The period—or periods—of mineralization are thought to be Ordovician or post-Ordovician.[1] A 30-ft. mineralized zone has been crosscut, but at present only 4 to 6 ft. near its walls is considered of commercial value. Vein filling is low grade, with shoots of higher grade, and the dimensions and the frequency of occurrence of the latter will probably determine the grade and tonnage of ore that can ultimately be mined. Possibly other veins may be found outside the walls of the deposit as now defined. Some cross-faulting has caused slight displacement in a few places. At the 112-ft. level the rock is strongly oxidized, but on the 220-ft. level it is fresh and unaltered.

[1]John T. Lonsdale, Virginia Geological Survey, Bulletin 30, 1927.



Grinding, classifying, and flotation at Rapidan corporation's plant

Economically important minerals are auriferous pyrite and free gold. Chalcopyrite and magnetite are found in small quantities. The principal gangue minerals are quartz, feldspar, and sericite. Pyrite is found in granular aggregates, in lenses of more massive character and as well-defined crystals, the latter particularly in the schist. Quartz occurs in stringers and lenses varying in width up to many feet. It is either milk white and massive or bluish gray with a more crystalline texture. Free gold occurs in the quartz in particles of microscopic size, 0.1 to 20 microns. Pyrite, except the cubical variety, also carries gold.

The Melville mine is opened by a two-compartment shaft 4½x9½ ft. inside the sawed-oak timbering. It is equipped with a 50-ft. headframe and a single-drum hoist actuated by a 52-hp. electric motor. A skip is soon to replace the sinking bucket in which the ore is still being hoisted and dumped into a 150-ton bin at the headframe. On the 112- and the 220-ft. levels crosscuts are driven through the deposit and drifts extend in both directions along the strike at both hanging wall and footwall. On the upper level about 900 ft. and on the lower level about 600 ft. of lateral work has been done, with an advance of about 260 ft. per month. A pillar between the upper level and the old workings is being taken out as the drift advances. A raise to connect the two levels has been started. Ore is hand-trammed to a shaft pocket on the upper level, while on the lower one cars are dumped directly into the bucket. A 1½-in. MRV-20 electric pump lifts the mine water to storage tanks for use in mill and power plant. An I-R 12x11 in. Texrope-driven air compressor, located in the power house, furnishes air for the mine.

Ore is delivered from the shaft bin to a sorting belt, where 8 per cent of the waste is rejected. Passing over a grizzly with bars spaced 1½-in., the ore goes to a 16x10-in. Farrel jaw crusher set to 2 in. The crusher product joins the grizzly undersize on a conveyor belt that delivers to a 125-ton mill bin. From this a Hardinge constant-weight feeder delivers the ore to a 6-ft. by 22-in. Hardinge ball mill in closed circuit with a 27-in. by 18-ft. classifier, set on a slope of 2¾ in. to the foot, the rakes making 27 strokes per minute. Classifier overflow at 25 per cent solids goes to four new-type Fagergren 28-in. round cells, of which three make rougher concentrates that are returned to the cleaner by means of a 1-in. direct-connected Wilfley pump. Cleaner concentrates are dewatered in settling boxes, then dried and sacked for shipment to the smelter. At present 75 tons per day is being milled, but with increased flotation capacity this will be increased to 90 tons or more. To release the gold completely it is necessary to grind to 80-85 per cent through 200 mesh. The pulp is naturally slightly alkaline, and the only reagents used are pine oil, 0.10 lb., and Reagent 301, 0.14 lb., per ton. Recovery is 93 per cent, with a ratio of concentration of 100 to 1.

Power for mine and mill is furnished by two Fairbanks-Morse diesel engines of 240 and 120 hp., respectively, direct-connected to a.c. generators delivering current at 2,300 volts that is stepped down to 440 volts for use in motors and to 110 volts for lighting.

The surface plant is well constructed and reflects credit on those responsible for its layout. Local labor is employed and has to be trained for work in mine and mill. At present capacity and with the mine in the development stage satisfactory low operating costs are being obtained.

Thanks are due C. Hyde Lewis, manager, for permission to publish this article. I also wish to express my appreciation of the assistance given by J. T. Hanvey, Jr., in preparing the data on the mine and to E. D. Hale, whose laboratory work has been of great help to me while breaking in a new mill with a green crew.

Hard Facing
Lengthens Life of Equipment

Specific Cases Show Benefit Derived From Use of Welding Material That Is Resistant to Shock and Abrasion

George Sykes

Haynes Stellite Company
New York

MACHINERY of all types is attacked by abrasion. When steel clashes on steel or dust interferes with good lubrication, or earth and stone grind away metal parts, some part of the equipment will inevitably show a decrease in life. Replacement means increased operating expense, loss of time in production, and perhaps complete paralysis of output until the new part is received and installed. The hard-facing process as applied to metal wearing parts has been found to be the answer to many of these difficulties.

In the mining industry abrasion is especially severe, for here it is usually accompanied by shock or impact. For reconditioning gyratory crusher mantles, crusher jaws, dipper teeth, and similar parts subjected to impact, the hard-facing material must be selected for its strength and toughness as well as its abrasion resistance. For jobs of this type, a self-hardening alloy of chromium, manganese, and iron, which is especially resistant to shock, has been found to be particularly successful. This material makes strong, tough welds with excellent resistance to abrasion and also has the property of work-hardening under impact. Following are some typical instances of the application of this alloy, which is known as Hascrome.

At Alaska Juneau, it is a regular part of the maintenance practice to build up and hard-face gyratory crusher mantles and the stationary and movable jaws of the 36x48-in. primary jaw crushers. Savings result through the longer life of hard-faced equipment and the decreased number of repairs and replacements.

One of the largest hard-facing jobs ever undertaken, the rebuilding of a 34-ton gyratory crusher, was recently completed at a Michigan mine. The shell of this 12-ft. diameter manganese-steel mantle is 5 in. thick. It had worn down approximately 1 in. at the deepest point, the wear tapering to zero about 14 in. from the bottom of the mantle. It was estimated that slightly more than 1,900 cu.in. of metal had worn away, and the operators of the plant decided to rebuild first with manganese steel followed by a final layer of hard-facing alloy. Fig. 1 shows the mantle lowered from the crusher housing so that the metal could be deposited in as flat a position as possible. A heavy steel cable can be seen wrapped around the shaft so that the 34-ton casting could be turned as the welding progressed. This cable was operated by means of a chain block, and the timbers on which the shaft of the mantle rested were notched and greased to facilitate in the turning.

The partly built-up mantle and the progress of the weld as determined by means of a straight-edge are shown in Fig. 3. Three beads of manganese steel were first deposited and the welds were staggered to eliminate heat effects and the possibility of melting the zinc liner. Approximately $\frac{3}{8}$ in. was thus built up and then completely covered with $\frac{3}{8}$ in. of hard-facing alloy. This job required 250 lb. of $\frac{1}{4}$-in. manganese-steel welding rod and 200 lb. of $\frac{1}{4}$-in. Hascrome rod, the total welding time being 104 hr. This, of course, included delays caused by turning the casting and by weather conditions. It was found that about 6 lb. of hard-facing alloy and 5½ lb. of manganese steel could be applied per hour. The hard-faced mantle is now back in operation and giving excellent service. Though it is as yet impossible to estimate its life, experience with similar jobs indicates that it will last at least twice as long as formerly.

In Fig. 4 is shown a crusher mantle recently rebuilt with hard-facing material at a Colorado mine. The extremely wide beads were obtained by laying eight $\frac{1}{4}$-in. rods side by side and then fusing them together with another rod used as an electrode. About 500 amp. were used, and succeeding layers were deposited at right angles to preceding layers. Recent reports state that the hard-faced mantle has crushed 108,000 tons, as compared with 60,000 tons for a new manganese-steel mantle.

The life of crusher jaws is also effectively increased by the use of hard-facing materials. Fig. 2 shows the rebuilding job on an 18x24-in. manganese-steel crusher jaw and also some of the coated rod which was applied electrically. The total cost of this job was $33 for material and labor. The skip method—that is, the staggering of the hard-facing deposit—was used to avoid overheating and warping the manganese jaw. Results show that the hard-facing alloy has an exceedingly long life on applications of this kind.

On the Minnesota iron ranges a method has been devised for applying Hascrome electrically to large jaw crusher plates without removing them from the crusher. A copper templet is propped up against the bottom of the crusher plate to act as a shelf for the alloy as well as to outline the desired shape. The operator is swung down from the top of the crusher in a rope cradle, and beads of the alloy are welded on the worn manganese-steel section against the copper baseplate. A small amount of welding is done on each corrugation in turn, to avoid producing too much heat in one spot. This method gives excellent results without warping or loosening the plate and is responsible for a considerable saving of time and expense.

A large copper company operating in New Mexico has standardized on the application of chromium-manganese-iron alloy to the manganese-steel liners of coal pulverizers. Fig. 5 shows some of the badly worn liners prior to the rebuilding operation. Mild steel was first used for filling up the holes as a base for the hard alloy. In applying the latter with the arc it was found that best results were obtained with the use of a flux. This flux is described further on. Detailed figures kept on this job showed that the total cost for building up 54 badly worn liners (there being sixteen to each set), including hard-facing alloy, steel, labor, and electrical power, was $420.93. This brings the cost of building up each liner to $7.79, or slightly less than one-third the cost of a new manganese liner. This application has proved so successful that in the future the liners will be taken out before they are so badly worn and

will be built up with hard alloy only.

Building up worn ball-mill liner plates with hard alloy has been found to be an economical procedure at a Colorado silver mine. In general practice, ordinary manganese-steel plates are replaced when they are worn 1½ in. in thickness, because frequently at that stage some sections have been reduced in spots to a thickness of ½ in. Their average life is about three months. These plates were hard-faced in place by attaching scrap steel to the worn faces and then building up the surfaces with hard alloy. Depending upon the amount of steel used, each of the eighteen plates required from 30 to 100 lb. of the alloy. Examination at the end of the first month, after 1,500 tons of ore had passed through the mill, satisfied the mine officials that the application was successful and economical.

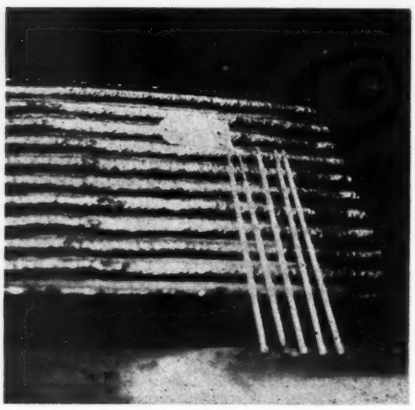


Fig. 2 — During welding the hard-facing was staggered to avoid overheating and warping this crusher jaw

One of the most common applications for chromium-manganese-iron alloy is for dipper bucket teeth, Fig. 6 showing a number of hard-faced manganese-steel teeth. This job was done with the arc, each tooth requiring approximately 5 lb. of material. To facilitate the hard-facing operation, a copper plate was placed on the work table with the top side of the tooth on the copper plate. The tooth was then built out about 1½ in. on a taper to conform to the shape of the original tooth and then the three sides were covered back about 6 in., leaving the top side free to wear and give a self-sharpening action. A bead was also run on the tip to sew in the ragged edges. Results show that hard-facing dipper teeth triples their life.

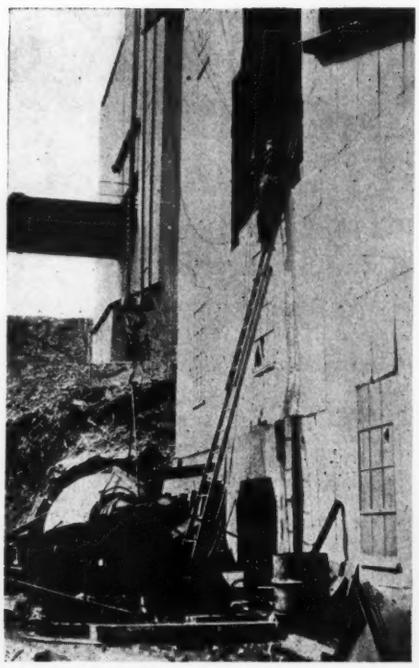


Fig. 1—At a Michigan mine. A steel cable wrapped around the shaft is used to turn this 34-ton mantle during welding

One major repair which saved an Idaho contractor approximately $200 was the building up of the badly worn lower edge of a bucket faceplate. This faceplate of manganese steel was originally 1¼ in. thick, but approximately 6 in. of the surface had worn down, leaving only ⅜ in. of material. Due to the wear, the bucket had become weakened and had begun to crack. Starting from the center of the plate, approximately 1¼ in. of hard-facing material was applied by the electric arc, both to stiffen the casting and to add additional life to the bucket. This job required 11 hr. to apply 50 lb. of hard-facing rod. The estimated cost of the repair of the bucket face was $90, whereas replacement of the part would have cost $285.

Fig. 7 shows a clamshell bucket and the method used in hard-facing the lips. These lips were worn back about ¾ in. and were built up solid with hard-facing material. A copper plate 14x3x¼ in. was used to back up the weld, as it is hard to hold a straight bead with the electric arc on such a narrow space. After each lip was built up high enough as determined by clamping straight-edges along the sides and drawing a string between them, a bead was run along the sides where the copper plate rested to sew up any irregularities. The two props used to keep the lips apart are clearly shown in the illustration. Experience has shown that this is the best way to handle the job, building up both lips first and then the sides, using a crane hoist to move the bucket. This job required 25 lb. of hard alloy. The bucket has now been in service five months, and only the front edge has rounded over and worn away less than ½ in. New manganese-steel lips used to wear down about 1¼ in. in five months with the same amount of service, and on this basis the hard alloy will outlast the

Fig. 5—These badly worn coal pulverizer liners were hard-faced at one-third the cost of new liners, by a copper company

Fig. 3. Left—Progress of weld of 34-ton mantle is determined by means of the straight-edge

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Fig. 4—A hard-faced crusher mantle at a Colorado mine. It crushed approximately twice the tonnage handled by a new mantle of alloy steel

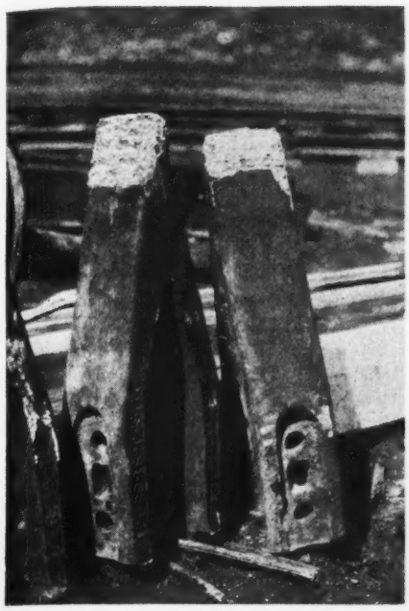

Fig. 6—Dipper teeth, when hard-faced, last two or three times longer

original manganese steel about three times.

Hard-facing has proved especially effective on all types of dredging equipment subjected to abrasive wear. Though the type of hard-facing material will vary with the locality, a Milwaukee dredging company has used hard alloy successfully for building up worn cutter blades. One of the company's cutters is a single casting without the usual removable cutter blades, and, when worn, the entire casting must be replaced, at a cost of approximately $700 if the blades are not rebuilt. However, this casting has already been rebuilt with hard-facing materials eight times, and the contractor estimates that hundreds of dollars have been saved from this one application alone. The hard-faced blades seem to wear down to almost a knife edge, which has proved ideal for working in a solidified formation of silica sand. When mixed with water, this formation presents one of the most abrasive combinations it is possible to find. This job illustrates excellently an important economy of hard-facing—namely, that hard-faced parts can be rebuilt over and over again almost an unlimited number of times.

The use of this hard-facing alloy on gold dredge bucket pins is another important application. These pins are faced to a depth of $\frac{1}{4}$ to $\frac{5}{16}$ in., and the 15 to 20 lb. of hard-facing material required is deposited in $5\frac{1}{2}$ hr. The first test pin faced with this alloy was removed from service after one year and five days, in which time the $\frac{1}{4}$-in. deposit has just about worn through. Nickel steel pins formerly used would last about five months, in which time they would wear away from $\frac{3}{4}$ to 1 in. The result is that the hard-facing of gold dredger bucket pins has now become standard practice.

Among numerous other hard-facing applications with this material are ball-mill distributor cones, coke crusher rolls, crusher bowl concaves (Fig. 8), gyratory crusher spiders (Fig. 9), snail scoop lips (Fig. 10), caterpillar tractor sprockets, caterpillar tractor treads, worn ends of manganese crusher bowl segments, latch plates, bucket bail brackets, latch plate shields, and feed rings for Bradley pulverizers.

Either the oxy-acetylene or the electric arc process may be used for depositing Hascrome, the former being recommended when it is desired to obtain a smooth and well-shaped deposit free from cracks. However, on most types of hard-facing jobs, this feature is unimportant, and the metallic arc will be found to be cheaper and faster. The metallic arc is always recommended for depositing the hard alloy on manganese steel, and generally for hard-facing large surfaces and parts hard to heat properly with the oxy-acetylene flame or subject to warpage in preheating.

Deposits of the hard-facing material discussed have a tensile strength of 40,000 lb. and a compressive strength of 177,000 lb. per square inch. Deposits made by the oxy-acetylene process have a hardness of 240 to 500 Brinell. Arc-welded deposits have a hardness of 240 to 400 Brinell depending on the cooling rate.

Fig. 8—Crusher bowl for gyratory showing the hard-faced concaves

Fig. 10—The lip of this rod-mill snail scoop is hard-faced to give it longer life

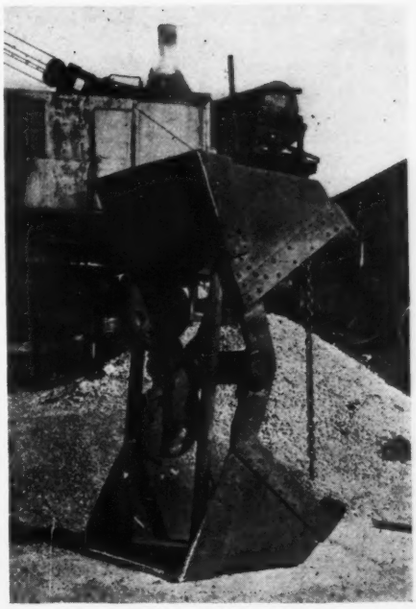

Fig. 7—Props were used to separate the lips of this clam-shell bucket during hardening

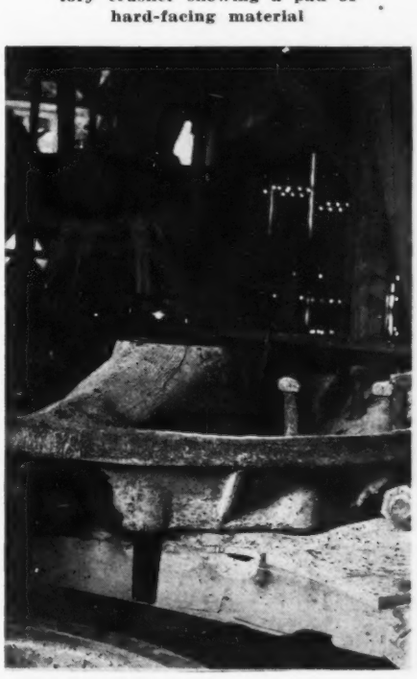

Fig. 9—The spider for a gyratory crusher showing a pad of hard-facing material

. . . Scrap . . .

Once Humble, Now an Important Factor In Metal Refinery's Business

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Receiving Department of United States Plant at Carteret, N. J., Is Well Equipped for Handling, Sorting and Sampling the Many Kinds of Material That Arrive

◆

Paul B. Garber

Superintendent, Scrap Metal Department, United States Metals Refining Company, Carteret, N. J.

EXCELLENT FACILITIES for receiving scrap by rail, water, or truck are available to the large plant of the United States Metals Refining Company at Carteret, N. J., by virtue of its location on Staten Island Sound, about 20 miles from New York City, and the proximity of the adjacent railroads and the main highways of the State. The company is a subsidiary of the American Metal Company.

All scrap is received and handled under the supervision of the scrap metal department, which is housed in a brick building, 500 ft. long. 138 ft. wide, and 38 ft. high. A broad-gage track running the entire length of the inside north wall of the building, with room for twelve freight cars, is used for incoming scrap received by rail. Another broad-gage track, for four cars, enters the central part of the building and is used for the disposition of various grades of metal after classification.

Two high-speed 5-ton electric Shaw cranes, erected on a 50-ft. overhead span, operate over the center aisle of the building. These are equipped with special hooks and chains and are used for moving the material through the various departmental operations. They also expedite the handling of heavy material received by truck. Thirteen electric lift and platform trucks and one crane truck are also used for transporting materials between the various departments, and three electric winches unload the heavy material from the cars.

Centrally located, directly inside the east end of the building, are two Logemann hydraulic compresses, for baling of the scrap after sorting. These are equipped with specially constructed conveyors, which deliver the finished bales to narrow-gage cars on the outside of the building. Under the crane runway are three 10-ton, built-in platform beam scales, evenly spaced over the length of the building, and a 20-ton truck scale with self-registering beam is found at the west entrance. Two Fairbanks broad-gage track scales, of 100 and 150 tons' capacity respectively, with self-registering beams, are used for weighing rail receipts. Additional equipment includes specially constructed wooden boxes with steel bottoms and ball-bearing casters, of 5-ton capacity, for movement of material after unloading, and drop-bottom steel boxes, also of special construction, used for transporting sorted material to the compresses.

An office for the supervisory and clerical force and facilities for sampling are situated on a mezzanine along the south side of the building. The sampling division is equipped with small oil-fired crucible furnaces, drill presses, crushers, grinders, drying ovens, and other apparatus for the efficient handling of the various types of samples.

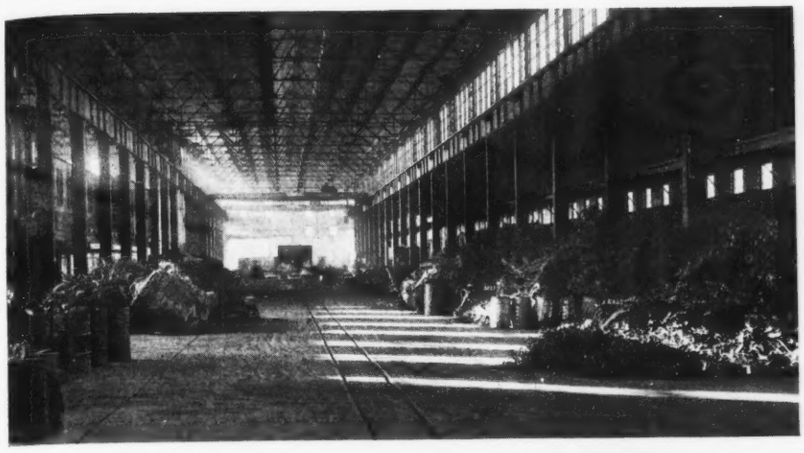
All contracts, covering description of purchased material, are made through the scrap division of the American Metal Company. Copies of these are forwarded to the plant, and material received is immediately inspected to ascertain if it is in accord with the terms. Whenever a preliminary inspection indicates that this is not the case, the shipper is immediately notified, to give him the opportunity either to make an amended contract or to order the material returned. No disposal is made of any questionable material until the shipper agrees to its release.

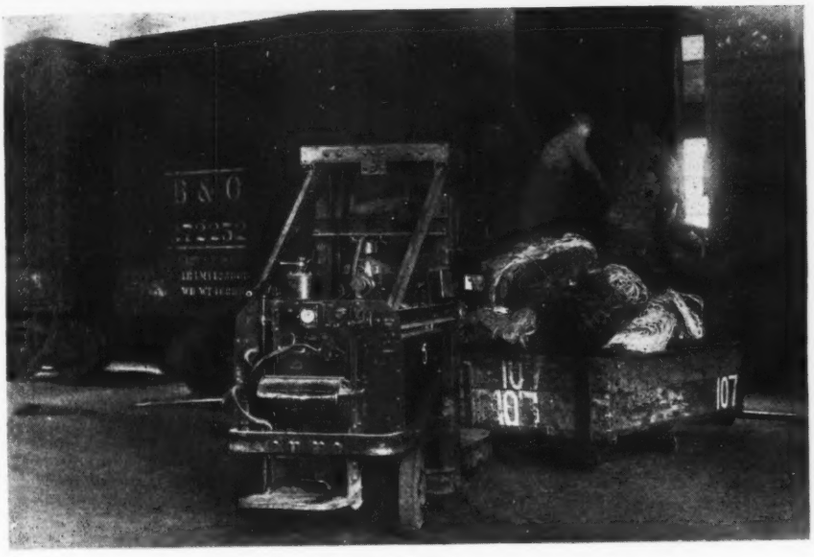
Particular care is given to the scales used at the plant in order that certified weight returns may be issued at all times. Every scale is tested daily under the supervision of the plant weighmaster, and at frequent intervals by the representative of a scale manufacturer, who makes any necessary adjustments and issues written certification covering the condition of each scale. Periodic tests on the broad-gage track scales are also made by the weighmaster of the Central Railroad Company of New Jersey.

The railroad track scales and the truck scales have self-registering beams, and all possibilities of errors in weighing by misreading the scale beams are thus excluded. Frequent checks indicate that the material weighed over these scales will check the weights obtained with the small scrap plant scales within 0.25 per cent. Preliminary weights are obtained as soon as possible after the arrival of the material. The plant receives an advice from the shipper on each shipment, and whenever the preliminary weighing, based on the actual gross weight and the stencil weight of car or truck, does not check within 1 per cent of the advised figure, the shipper is notified accordingly and given an opportunity to check the figures before the material is unloaded.

Two weighers are used for operating the small scales, each of which has a definite number of weights. While one weigher reads the scale beam, the other arrives at the weight of the material by reading the weights not used. The two figures thus obtained must agree before the material is removed from the scale. Our experience is that this method prevents the possibility of an error occurring through two men misreading a beam.

Broad-gage cars are generally unloaded by hand into the wooden containers, which are transported by lift truck to the center aisle and then delivered to the next operation by the overhead cranes. However, where this is





In the scrap-receiving department at the plant of United States Metals Refining Co., Carteret, N. J.

Top—Scrap ready for classification at the receiving plant

Middle—Unloading a car of copper wire

Below—Moving scrap by overhead crane. The plant office is at the left

not practicable, on account of tangled wires or too heavy packages, unloading is done by dragging with an electric winch with cable attachment. This not only speeds up the work but also prevents the danger of accident resulting from heavy lifting and straining.

Shipments of scrap are received in various forms, sometimes entirely loose, sometimes in bales, bundles, or briquets, and at other times in a combination of containers, such as drums, barrels, or boxes. Dealers usually sort their scrap before shipping; however, a dealer's classification frequently will not correspond to specifications under which the material was purchased, and further sorting may be necessary upon arrival. Inspection of a shipment received will give an approximate idea of extra classification, and the shipper may be notified if any portion of a shipment varies from the contract. Any extra handling expense involved in sorting is charged to the shipper and deducted from the final settlement.

At times shipments contain small scrap which can be shoveled, but which is mixed with larger pieces that can be unloaded only by hand. The large material is then picked out and treated as a separate item, later to be combined with the finer material.

No sorting is done during the unloading. The wooden containers are picked up by chains attached to the overhead cranes and transported to the center aisle, where the contents are dumped on the floor in any available space. Here the material is then unpacked and sorted by hand. The upright columns supporting the crane runways are all numbered, and the location of each lot on the floor is recorded according to the number of the nearest column.

Sorting is done by hand, shears being used to clip off attached foreign material when necessary. The sorted scrap is placed in steel boxes with hopper bottom controlled by a hand lever at one end. These are transported to the baling presses on electric storage battery trucks. They fit over the compress box, and the content may be unloaded directly into the latter by releasing the hopper; whereupon it is pressed into bales measuring 18x18 in. and weighing from 250 to 800 lb., according to the nature of the material.

Scrap receipts are generally classified as follows:

No. 1 Copper Scrap—Heavy copper and wire not less than 1/16 in. thick, trolley wire, heavy field wire, heavy armature wire, copper clippings, punchings, and copper segments, all to be clean, untinned, free from burnt, brittle copper wire and all foreign materials. Hydraulically baled or briquetted copper is not acceptable.

No. 2 Copper Scrap—Copper and wire, miscellaneous clean copper wire such as of necessity would have to be taken out of No. 1. Heavy copper and

wire, free from hair wire and burnt, brittle wire. A minimum copper content of 95 per cent, determined by electrolytic assay, is required.

Light Copper—Bottoms of kettles and boilers, stills, bath tub linings, hair wire, burnt copper wire, roofing copper, and similar materials. It must be free from radiators, brass, mixed, screens, alloyed materials, readily removable iron, old electrotype shells, and without excessive paint, tar, and scale.

Insulated Copper Wire—All wire covered with insulating substances such as rubber, paper, and fiber.

Brass Scrap—Copper bearings, metallic brass according to grade, radiators.

Lead Scrap—Battery lead, lead drosses, sulphates, and other salts; miscellaneous scrap and cable lead.

The percentages of the various classes of scrap received vary considerably from month to month.

Practically all scrap is purchased on the basis of metal content and must therefore be carefully sampled. Scrap wire, light copper, and similar large materials which cannot be shoveled are generally sampled by taking a representative portion of the material, amounting to about 250 lb. from each lot. Material which can be shoveled is sampled systematically by taking every fifth, tenth, or twentieth shovelful, depending upon the size and the nature of the lot, and this sample is worked down by quartering to about 250 lb.

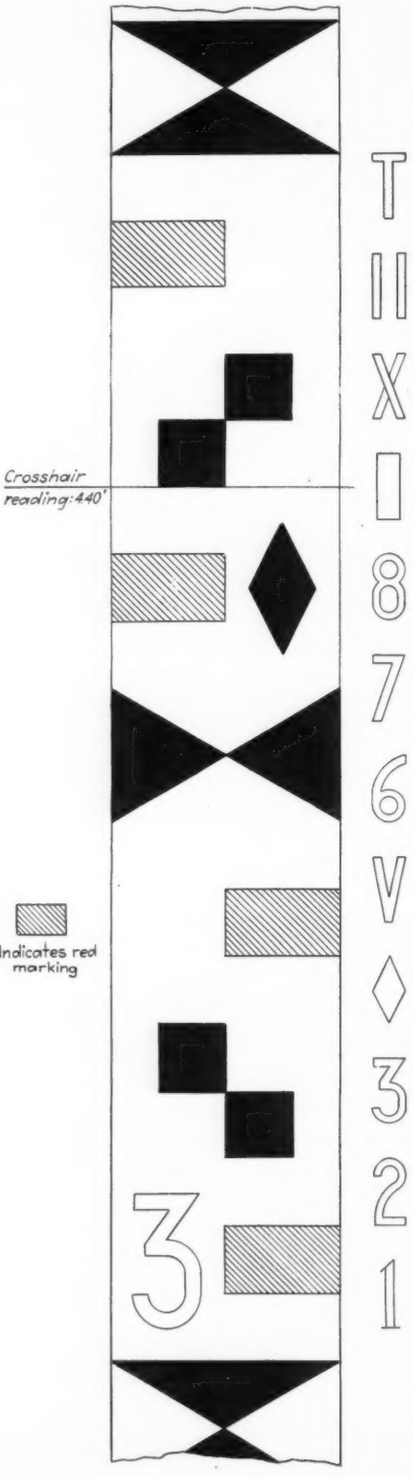
All samples are delivered to the sampling department for final preparation for the laboratory. Samples containing large pieces are first cut into sections of about 2-in. size. The sample is then mixed thoroughly and quartered down to about 100 lb., one half of which is placed in sealed containers and held in reserve for a period of not less than 60 days after the arrival. The other half is now ready for the sampling furnace. Final samples weighing from 25 to 100 lb. are weighed on a gram scale by two weighers, in the same manner as previously described, and then delivered to the furnace room. Here the sample is placed in a graphite crucible and melted down with a fluxing agent, if needed. in an oil-fired crucible furnace under controlled temperature. After melting the resulting bar is cleaned from all adhering slag particles and weighed. The slag is also weighed and the weights are recorded for the laboratory.

The bar is drilled by the templet method and the slag is crushed and pulverized to minus 80 mesh, and the drillings are ground to pass a 20-mesh screen. Drillings and slag are then placed in separate packages for the analytical laboratory. On these packages are recorded the name of the shipper, description of the material, contract number for information of lots in checking up determinations required, and all sampling data needed for calculations.

After unloading, weighing, and sampling the scrap is either baled or loaded into cars for further treatment.

Handling of secondary metals calls for the greatest care in supervision, checking, and recording. To avoid errors, all weights and all sampling data should be checked twice. From the weight reports from the scrap plant office and the analytical certificates from the laboratory the metal accounting department is able to calculate the metal content of each shipment, and to issue the final returns to the New York office. Settlements to shippers are made on the basis of these returns.

New Stadia Rod Marking



BEFORE PROCEEDING with some plane-table surveying for the Illinois State Geological Survey, development of a stadia board of his own design was necessary, writes William A. Blomstran. Desiring a rod that could be quickly read at long distances, the marking method shown in the accompanying sketch was employed, the graduations being painted on the usual 13 ft. folding stadia board, such as is commonly used by the topographers of the United States Geological Survey. In a few instances, shots as long as 2,000 ft. were easily taken.

Detail of Construction

Features of the rod are as follows: Even foot marks are different than odd foot marks, and the even fractional markings are on the left side of the rod, whereas the odd fractional markings are on the right-hand side. The figures are opposite the fractional markings which are painted red.

The board is first given a heavy coat of clear white enamel, and, when this has become thoroughly dry, the black and red markings are laid out with a steel tape, and then painted. A convenient arrangement is to have the 6½-ft. mark at center of the hinge where the board folds. A sample of easily distinguished figures is shown beside the accompanying sketch of a section of the rod.

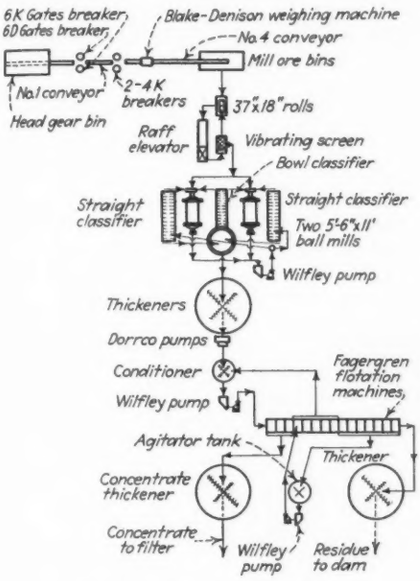
Owing to the shape and the arrangement of the markings, no need exists for guesswork or counting from the foot mark to the various tenths marks, as is necessary where the markings are a series of points. The two- and three-tenths, and the seven- and eight-tenths marks are readily seen to be on their respective sides of the red markings with relations to the center marking. The center marking alone includes the four-, five-, and six-tenths marks, which cannot be mistaken because of the position of this center mark in relation to the figure that designates the exact foot on the rod. The figure designating the exact foot appears directly above the foot mark on the rod, and the center mark is turned in such a way as to allow sufficient clear space for this figure, thereby not showing just a blur at long distances. The figures are two-tenths high by one-tenth wide.

Mount Morgan, In Queensland, Revived

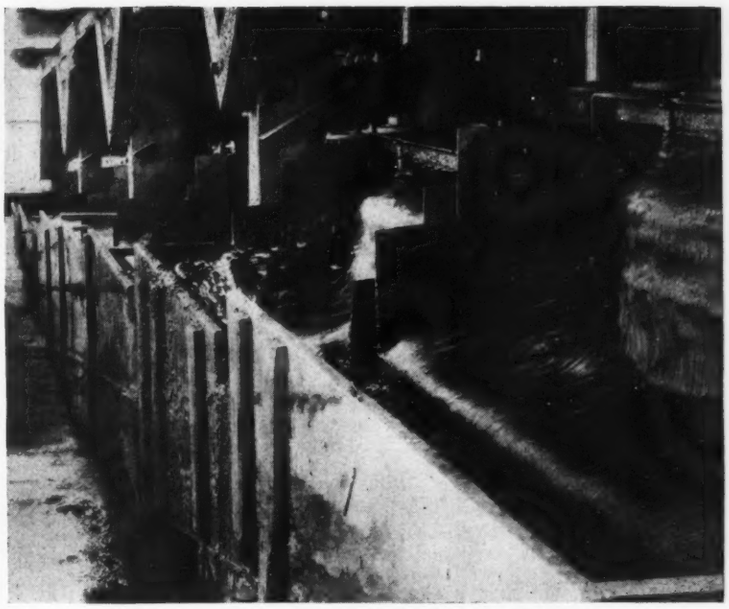
Now Milling 3,500 Tons of Gold-Copper Ore Weekly

M. W. von Bernewitz

Consulting Engineer



Flowsheet of 500-ton unit in Mount Morgan mill



Fagergren flotation cells in operation at mill of Mount Morgan, Ltd., Queensland, Australia

THE "come-back" of Mount Morgan as a gold and copper producer is well known. With Mount Coolon, the Golden Plateau, and the Golden Mile, the property has shared in recently increasing Queensland's gold output eight times since the "low" of 1929. The general manager of Mount Morgan, Ltd., A. A. Boyd, has kindly given the accompanying flowsheet of a 500-ton unit in the company's mill, and the illustration shows Fagergren flotation cells in the mill.

Mount Morgan has developed 8,000,000 tons of ore averaging 4.7 dwt. of gold and 1.72 per cent copper. About 600,000 tons of this, above the Linda level, is available for quarrying. The weekly output is 3,500 tons, but this is soon to be increased to 5,000 tons. When the quarry is opened enough to give the necessary space, electric shovels will replace hand-shoveling.

After leaving the quarry, the ore is dumped into the main-shaft ore packet, near the top of which is a Hadfield 30x36-in. jaw crusher equipped with a chain feeder. All ore passes through this breaker and is then hauled to the headgear bin. The accompanying flowsheet shows the sequence of operations. Concentrates are sent to Port Kembla, New South Wales, for smelting. Details of a typical monthly return are shown in the accompanying table. Dividends are being paid, and the future is bright for this once great gold mine and potential big producer.

Typical Monthly Return

Ore quarried, tons	11,346
Assaying:	
Gold, dwt. per ton	6.13
Copper, per cent	0.43
Concentrator treated, tons	10,360
Estimated contents:	
Gold, oz.	2,297
Copper, tons (89,600 lb.)	40

Zinc as Secondary Carbonate

Some Interesting Occurrences in the Black Rock Mine Disclosed in the Course of Sampling

Thomas Edwin Smith

2700 Phillips St., Butte, Mont.

DEEP-SEATED BODIES of zinc carbonate have been found in the mines in the Butte district of Montana, whose origin is probably subsequent to mining operations in the immediate vicinity. During 1925-26 I was sampling in the Black Rock mine of the Butte & Superior Mining Company. In the course of my work I found seven bodies of light-colored rock resembling the ordinary altered quartz-monzonite of the Butte area, except that it carried values in zinc sufficiently high to warrant shipping it for ore.

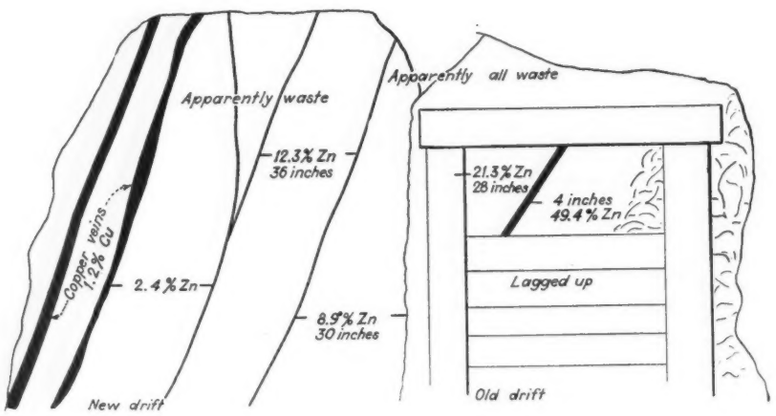
A prospect hole had been drilled on the 900 level, and assays of the drill cuttings showed a 12-ft. body of 15 per cent zinc ore. Later a drift was driven in to cut the orebody, and when the first round was taken out I went in with the shift boss to look at it. The broken ground showed a few traces of black streaks and spots in a mass of soft white rock, and the shift boss ordered the entire pile sent out as waste for stope filling. I sampled the pile, being careful to eliminate any black material. Assay returns showed 11.8 per cent zinc and 6.3 oz. silver.

Another orebody looked like ordinary

barren, altered country rock except for the presence of numerous translucent particles somewhat larger than the usual quartz grains. This sample assayed 21.3 per cent zinc. In still another place, a body of conventional black zinc ore was found adjacent to what looked like ordinary barren waste rock. I sampled both. The black "ore" assayed 9.0 per cent zinc and the white "waste" 9.8 per cent. A train of "ore" and a train of "waste" had been loaded out of this place and tagged according to color. The two were sampled separately. The study specimen we had a hand specimen and a quantity of pulp.

After coarse crushing, some of the material was panned to separate it into three parts:

1. White, cloudy liquid and some floating elongated angular particles that could be poured off without disturbing the remainder of the material in the glass. This had a high zinc content. Later, the long, angular, floating particles were separated from the cloudy liquid and tested. They showed practically no zinc.



Occurrence of white zinc ore in Black Rock mine

former assayed 9.4 per cent zinc and the latter 9.7 per cent zinc.

Three bodies of similar white zinc ore were cut in prospect drilling, and in each case the water coming out of the drill hole was cloudy and settled slowly. Drill cuttings when panned yielded very little sulphides or other heavy material.

The accompanying sketch shows the largest body of white ore that I found. The zinc-bearing rock is the equivalent of 8 ft. 2 in. of 15.3 per cent ore. Nevertheless, all these bodies were dumped into stopes for filling because they did not look like the ordinary run of zinc ore in the mine.

Ore Character

In cooperation with I. W. Anderson, chief chemist of the company, I spent much time studying this ore to determine its character. Several samples were collected. Before being assayed, each fragment of rock was broken in two, one piece being ground for assay and the other kept for hand examination. The assay pulp was taken out and the rest placed in an envelope bearing the assay number. The hand specimen was put in another envelope, which was given the same number. Thus for each

2. Silica and silicates. Very low zinc content.

3. Concentrates, mostly pyrite. Very low zinc content.

Whatever zinc was in the material was in the cloudy liquid that could be poured off the other material. This agrees with our observations when drilling prospect holes.

More of the material was crushed coarse but not panned. Some of it was placed in a watch glass on a glass pedestal, tested with several reagents, and the behavior observed through a thirty-power lens. The light-colored, high-grade zinc ore appeared much like the altered monzonite except for the larger translucent grains. The granular particles were surrounded by a white cementing substance, which under the lens appeared to be, in part, an amorphous white powder and in part microscopic, translucent crystalline particles. When treated with warm, dilute hydrochloric acid, considerable effervescence from the white amorphous powder surrounding the grains and crystalline material was observed. No action was noted on the grains or crystalline particles themselves. When cold dilute sulphuric acid was used, similar effects were observed, but the action was slower. It is noteworthy that there was no smell of hydrogen sulphide when the white zinc was dissolved in sulphuric acid.

All the white zinc ores were heavy. The specific gravity of that running 49.4 per cent, which is indicated in the accompanying sketch, was 4.11. Other determinations ranged from 3.75 to 3.95.

Genesis

All evidence tended to confirm an earlier hypothesis that the white zinc was a precipitation in barren rock from sulphate solutions.

Pyrite in the presence of air and moisture alters into ferrous sulphate and sulphuric acid. The sulphuric acid thus produced acts upon adjacent material to produce soluble sulphates of the metals, zinc among them. This is the usual method of its production in mines. In many cases, however, zinc sulphate seems to be produced by the normal oxidation of zinc blende without the action of sulphuric acid, and, being so readily and completely soluble, finds its way into the mine-water circulation.

The country rock of Butte consists mainly of feldspars, and in the mineralized zone the feldspars weather and disintegrate much more rapidly than does similar rock on the surface. This disintegration liberates carbonates of sodium, potassium, calcium, and magnesium, with subordinate amounts of iron and manganese carbonates and bicarbonates. At the same time, colloidal silica and kaolin are produced.

When a weak solution of mixed metallic sulphates trickles through old gobs or shattered country rock, it comes in contact with the carbonates of the alkalies and alkaline earths, and the metals are precipitated in the following order: Alumina (if present), iron, manganese, copper (if present), and lastly zinc. Such a solution percolating through weathered rock of relatively small extent can have all its alumina and iron removed and trickle out below, carrying its original load of copper and zinc. Through a larger body it may lose its copper, too, and emerge as a solution of zinc sulphate, relatively pure. But if the solution be given time enough, and a sufficient amount of weathered rock is available, the zinc will be deposited in the interstices as a basic zinc carbonate.

By repeated experiments I accomplished the separation and precipitation of the various heavy metals from a sulphate solution, determining the end stage of the process by varying the quantity of weathered waste in contact with the solutions.

Zinc is such a common metal in most mines (and frequently a troublesome one, too) that deposits of such ores as have just been described are likely to be encountered anywhere. Old gobs and areas of shattered country rock should be sampled and analyzed to determine their zinc content if the ore had contained zinc as an original constituent.

Planning for Pensions In Industry

Successful Systems Must Be Based on Sound Actuarial Principles And Other Fundamental Policies

G. Chauncey Parsons

New York, N. Y.

Employer-employee relations have become of increasing importance as factors in programs for promoting industrial recovery. They have given rise to numerous plans and proposals on the part of both management and labor, and are the subject of prospective legislation. In view of current interest in the subject, and its future importance, a review of the status of one of its elements—industrial pensions—and consideration of the fundamental bases of sound pension plans, is appropriate at this time. This article is condensed from a series of three papers by the same author, published in *The Annalist*, New York.

DATA compiled by the United States Census for 1930 record the fact that 48,829,920 persons were gainfully employed in this country in that year. About 4,000,000 employees are now covered by industrial pension plans, and about 130,000 pensioned employees are drawing approximately $90,000,000 per annum in pension benefits. In January, 1932, about $625,000,000 was estimated to be held as reserves against this liability; but the actuarial liability is estimated at $2,000,000,000 now, increasing by $150,000,000 to $250,000,000 per annum on existing plans only. Adequate funding for this liability would require from $250,000,000 to $400,000,000 per annum. The employee contribution now amounts to about $20,000,000. Obviously, some plans now in operation are not on a sound actuarial basis.

Pension plans in effect in this country today had their origin in employee mutual welfare organizations. At the time of this country's industrial expansion after the Civil War, some benefit for employees so incapacitated that they could not work was found to be necessary. These mutual benefit plans were on the basis of employees' contributions to a fund providing a small income to any member of the fund in case of disability. Later some of these plans were broadened sufficiently to cover superannuation, but on a very limited basis. They were very unsatisfactory.

Since 1900 a great many uninsured non-contributory plans have been established. By this I mean plans in which employees make no contribution to the pension fund. Uninsured contributory plans have also been put into effect to some extent. Most of these plans have been administered by the companies themselves, although in a few instances trustees have been appointed to manage the funds.

From 1914 to 1928 a considerable number of the non-contributory plans were changed to the contributory type, and since 1928 many more have been insured, as the managements apparently realized the hazard and were glad to pass the responsibility on to an insurance company. Many examples of non-contributory, self-administered plans which were changed to contributory plans and finally to insured plans have become increasingly apparent. A great many of the non-contributory pension plans have, however, been changed, discontinued, or withdrawn with respect to new employees. In some pension systems age and service requirements have been raised, maximum and minimum pensions reduced, or earned pension credits cancelled. In still other instances, where employees have already been pensioned, payments have been reduced. This has been a severe hardship upon the employee. Had these plans been set up on an actuarial basis originally, and administered correctly, this hardship would have been avoided. Some of the changes were caused by mergers, but most of them are attributable to unsound plans, aggravated by economic conditions.

Under the insured plan—that is, a pension plan underwritten by a life insurance company on a sound actuarial basis—a contract is made which includes in its provisions the employee, the employer, and the insurance company. The insurance company in effect acts as a trustee of both the employees' and the company's contributions which constitute the reserve or sinking fund against the ultimate pension. Such a contract is not subject to any of the vicissitudes of management. It is not subject to alterations due to changes in boards of directors or officers, except for future terms, nor to changes in economic conditions. Even the failure or merger of the company can in no way destroy the pension already purchased.

Under the contributory insured plan the employee is really a partner and shares in the cost of his or her pension by weekly or monthly deductions from pay which are paid to the insurance company by the employer. The insured plan is a fundamentally sound financial transaction. The reserve set up for the future pension is funded out of current company earnings; that is, during the time when the future pensioner is on the payroll and is actively working and producing. This is the correct time to buy the pension; the cost should not be passed on to future management and future employees, to say nothing of future stockholders.

By using an insured plan, corporations can avoid becoming involved in a business about which they usually know nothing. They are not actuaries; they are not trustees. All business has a speculative hazard. The management of an organization should be free to give its entire time, thought, and energy to the direction of the business, and to expect it to operate an insurance business at the same time is not fair to either the employee or employer; nor

should the pension plan be subject to the speculative hazard of the business. The use of insured plans as against the old type of uninsured plans has been found to increase loyalty. Workmen who can look forward to a reasonably adequate income in their later years are, of course, better workmen than those who have nothing to look forward to but a dependent old age.

Funding Essential

To be sound, a pension plan should be funded. By this I mean that it should be purchased by an annual or monthly contribution or premium during the time when the employee is an active producer. This premium should be charged against current earnings and not based on probable future earnings. The costs on this basis are less because compound interest has time to work. If the pension is bought on the so-called unfunded or annuity basis, it costs more in the end and is subject to hazards not found in the funded plan.

Many non-contributory plans properly funded or insured are sound, but they put more of a burden on the employer than contributory plans. To bring home to the employee the benefit of a pension plan, he or she should be a participant in the cost. If the employee is not willing to share in the cost of his or her own pension, then, obviously, no pension should be purchased. Often the stipulation is made that unless employees join the pension plan, no past service credits will be purchased for them. In some companies it is one of the requirements of employment. So far I do not know of any employees who have declined this opportunity of joining a plan. They have everything to gain and nothing to lose.

What Constitutes an Adequate Plan

The monthly pension payment at normal retirement age should be adequate to provide at least the necessaries of life. The modern trend is to guarantee a minimum pension to the retired employee, the amount being dependent upon his work, compensation, and the locality. After a normal lifetime of work, the pension should provide more than a bare living, and any properly designed pension plan will do so. Wherever possible the retirement amount should be that which will approximate as closely as possible the employee's standard of living prior to retirement.

Under certain conditions it has been found advisable to place a limit or to establish a maximum salary in the consideration of a pension plan. In some plans this has been set at $5,000 per annum; in others, $10,000, and so on. That any definite salary limitation can be set covering all businesses or industries is hardly likely, however. Each case must be considered on its own merits. The necessity of a pension on salaries of, say, over $25,000, is not so obvious as for those under that amount.

The monthly contribution of the employee should always be, and is in insured plans, kept separately on the books of the insurance company from the amount contributed by the employer. The employee's contribution should be returned to him or her if he or she leaves the company. If death occurs before normal retirement age the contribution should be paid to employee's beneficiary or estate.

The company's contribution should cover current pension requirements and should preferably be paid monthly. These contributions should not be subject to withdrawal because of change in economic conditions, change in management, merger, or liquidation. Under certain conditions, however, such as the employee leaving after a short period of employment, the amount paid by the company should be returned or credited against future premiums.

Under certain conditions the employee should also get the benefit of his or her employer's contribution, but only in the form of a paid-up pension beginning at normal retirement age.

Costs of an Insured Pension Plan

Present practice in insured plans is for the employer to pay from 50 to 75 per cent of the total cost of the pension fund. However, I believe that the proportion will eventually be about 50 per cent for the employer and 50 per cent for the employee.

Current year-to-year costs vary, of course, with different age groups of employees, and may be from 3 to 5 per cent of the current payroll. Also, the percentage of women in the company has an effect, for they are usually retired at an earlier age and have greater longevity. In estimating future costs allowance must be made for increases in the number of employees due to the expansion of the business, but this does not have any effect upon the percentage of the payroll.

If the pension plan can materially increase employee efficiency (and this has been done), the pension actually costs nothing.

The usual retirement or pension age in this country is 65 for men and 60 for women. Latterly, in certain types of business, the ages for men have been 60 and 55 or 50 for women. The management should always have the privilege of retiring the employee prior to normal retirement age. Retirement after normal retirement age can be worked out by mutual agreement. However, pension payments should begin to the employee at the specified normal retirement age.

For future service (that is, service beginning at the time of the installation of the pension plan) the usual amount of pension is 1½ per cent of the salary times the total number of years of service. But in many instances and in certain kinds of business this has been found to be inadequate and has been placed at 2 per cent or even 2½ per cent.

For past service (that is, service beginning at the date of employment and continuing to the date of installation of the pension plan) in most plans credit is given the old employees for service prior to the installation of the plan. This is also based on payroll and is usually calculated at 1 per cent of the present salary times the number of years of past service. The reason 1 per cent is used rather than 1½ per cent for past service is that the present salary is considered rather than total salary, and it has been found that 1 per cent of the present salary is approximately 1½ per cent of total past salary average.

Employee's Contribution

The employee's contribution is usually 3 per cent of his salary for a 1½ per cent pension; or 4 per cent of his salary for a 2 per cent pension; or 5 per cent of his salary for a 2½ per cent pension. This method of computing the employee's contribution makes the amount contributed by the company somewhat disproportionately heavy, particularly for those employees taken on its payroll in their later years. In future pension plans, I believe, where it is possible, adjustments should be made in the employee's contributions, so as to equalize this condition. The employee's contribution should earn interest. Some non-interest plans have been and are being installed, but the question always arises in the employee's mind, "What has become of the interest earned on my contribution?" To ask the employee to contribute to a pension plan for, say, twenty years, and then, if he or she leaves the company's employ, to return the contribution without interest, seems hardly fair.

Premiums should be paid monthly by the company, the company in turn making a salary deduction on regular paydays.

Employer's Contribution

The employer's contribution, of course, must make up the deficiency between the employee's contribution and the amount necessary to provide the pension as set forth in the plan.

The premium for past credit can be paid in the form of a single premium and is a non-recurring charge. This is often large (it may be financially impossible in one payment), but over a period of years amortization can always be arranged. The employer's contribution should also earn interest.

A probationary period applicable to all employees should be provided for in all pension systems. The length of this period varies, among different industries, from six months to two years. The plan should provide that, in the event of a lay-off, the pension plan be either continued for a reasonable time or held in abeyance until such time as the employee returns to work.

NEWS OF THE INDUSTRY

Roosevelt Nationalizes Silver At 50.01c. an Ounce

President's Proclamation and Executive Order of Aug. 9 Provide for the Seizure By "Eminent Domain" of All Stocks of the Metal in Continental United States—Mine Production Continues to Command 64½c. at Mints

NATIONALIZATION of silver was ordered by President Roosevelt in a proclamation and Executive Order issued and made effective on Aug. 9. All stocks of the metal in continental United States are to be turned in at the mints within ninety days, with the exception of silver falling in certain categories listed in Sections 2 and 6 of the Executive Order, the text of which sections is appended hereto.

Payment for the silver thus acquired by the government, which method of acquisition has been described by the Treasury as being seizure by "eminent domain" rather than purchase, will be at the rate of 50.01c. an ounce. The Silver Purchase Act of 1934 (see *E.&M.J.*, July, 1934, p. 320) provided that no purchases of silver in continental United States on May 1, 1934, should be made at more than 50c. an ounce. The 50.01c. "eminent-domain" rate is prescribed in the proclamation, which sets forth that when the silver is delivered to the mints "there shall be returned therefor in standard silver dollars, silver certificates, or any other coin or currency of the United States, the monetary value of the silver so delivered (that is $1.2929 + a fine troy ounce), less a deduction of 61 8/25 per cent thereof for seigniorage, brassage, coinage, and other mint charges." Newly mined silver will be bought as heretofore at 64½c. an ounce.

In his proclamation President Roosevelt declared that nationalization of silver had been ordered "to effectuate the policy of the Silver Purchase Act of 1934, to assist in increasing and stabilizing domestic prices, to protect our foreign commerce against the adverse effect of depreciated foreign currencies, and to promote the objectives of the proclamation of the 21st day of December, 1933 [see *E.&M.J.*, January, 1943, p. 37], relating to the coinage of silver."

Relative to coinage of the silver delivered to the mints, the proclamation provides that "silver so delivered shall be added to the monetary stocks of the United States and shall be coined from time to time into standard silver dollars in such amounts as are required to carry out the provisions of this proclamation and to provide for the redemption of silver certificates."

The Treasury stated on Aug. 10 that a decision had been made to exercise full rights under the Gold Reserve Act of 1934 (see *E.&M.J.*, February, 1934, p. 79) and subsequent Presidential orders to issue certificates on the basis of the full statutory value of the silver stocks held by the Treasury prior to the approval of the Silver Purchase Act. On silver acquired since the approval of this act, certificates were still being issued on a basis of the cost price of the metal.

Senator Key Pittman, of Nevada, who led the Senate forces supporting the bill under which the President's action was taken, was quoted as saying that nationalization of silver would lead to events which eventually would "settle the silver question forever."

"It is a process that will hasten the complete absorption of the silver surplus in the world," Mr. Pittman declared. "As this surplus is absorbed in the Treasury of the United States, the price of silver will steadily rise until it reaches $1.29 an ounce.

"Then the governments of the world will be in a position to open their mints for unlimited coinage at the ratio that exists in the United States.

"This will settle the silver question forever."

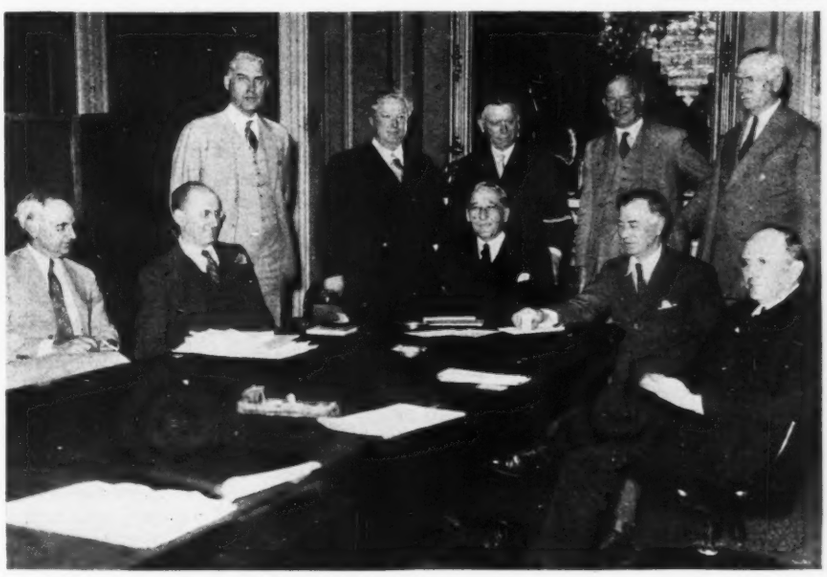
Exempt Silver

The text of Sections 2 and 6 of the Executive Order follow; these sections define the silver that is exempt from seizure:

Section 2. Silver Required to be Delivered—There shall be delivered in accordance with the terms of this order all silver situated in the continental United States on the effective date hereof, except silver falling within any of the following categories so long as it continues to fall thereunder:

Their Objective Achieved. Senate leaders who advocated steps taken by the President on Aug. 9 gathered in the office of the Secretary of the Treasury just before adjournament of the last Congress. Left to right, seated, are Herman Oliphant, Assistant Secretary of the Treasury; Secretary Henry Morgenthau, Jr., and Senators William H. King, of Utah; Key Pittman, of Nevada; and Alva B. Adams, of Colorado. Standing are Senators Hendrik Shipstead, of Minnesota; Pat McCarran, of Nevada; William E. Borah, of Idaho; Burton K. Wheeler, of Montana; and Elmer Thomas, of Oklahoma.

Times Wide World



A. Silver coins, whether foreign or domestic;

B. Silver of a fineness of .8 or less which has not entered into industrial, commercial, professional, artistic or monetary use;

C. Silver mined after Dec. 21, 1933, from natural deposits in the United States or any place subject to the jurisdiction thereof; provided, however, that so much of such silver so mined in the Continental United States on or before the effective date of this order which shall not have been deposited with a United States Mint under the proclamation of Dec. 21, 1933, shall, if processed to a fineness greater than .8 within seventy-five days from the effective date of this order, be delivered in accordance with this order, not later than ninety days from the effective date hereof, or if processed to a fineness greater than .8 after seventy-five days from the effective date of this order, be delivered within fifteen days thereafter in accordance with this order;

D. Silver held for industrial, professional, or artistic use and unmelted scrap silver and silver sweepings in an amount not exceeding in the aggregate five hundred fine troy ounces belonging to any one person;

E. Silver owned on the effective date hereof by a recognized foreign government, foreign central bank, or the Bank for International Settlements;

F. Silver contained in articles fabricated and held in good faith for a specific and customary use and not for their value as silver bullion; or

G. Silver held under a license issued in accordance with Section 6 hereof.

Section 6. Licenses—The Secretary of the Treasury, subject to such regulations as he may prescribe, acting directly or through such agency or agencies as he may designate, shall issue licenses authorizing the withholding of silver which the Secretary of the Treasury, or such agency as he may designate, is satisfied

(A) Is required for legitimate and customary use in industry, profession, or art by a person regularly engaged in such industry, profession, or art in the business of processing silver or furnishing silver therefor;

(B) Has been imported for re-export; or

(C) Is required to fulfill an obligation to deliver silver in such amount to a third person, incurred or assumed by the applicant on or before the effective date of this order; provided that, at the date of the application, the applicant owns such silver or holds the obligation of another to deliver to him such silver.

The Secretary of the Treasury may, with the approval of the President, issue licenses authorizing the withholding of silver for purposes deemed to be in the public interest and not inconsistent with the purposes of the Silver Purchase Act of 1934 and of this order.

Plans Mature for Mining Congress Meeting in San Francisco

Codes, Labor, Silver, and Unemployment Insurance Among the Topics of Current Interest on Program of Western Division—Problems of the Gold Mining Industry to Be Discussed—A Large Attendance Anticipated

OPPORTUNITY to hear lively discussion of the many problems that beset the mining industry today will be had by those attending the forthcoming meeting of the Western Division of the American Mining Congress at the Palace Hotel in San Francisco on Sept. 24-29. The Congress will open with a noonday luncheon at which Howard I. Young, president; W. S. Boyd, chairman of the Western Division; W. Mont Ferry, chairman of the Program Committee, and James F. Calbreath, secretary of the Congress, will meet the delegates.

Speakers at the opening session and their respective topics will be: W. Mont Ferry, "Rehabilitation of Non-ferrous Metals"; Senator Key Pitmann, "Administration of the Silver Bill"; and Mr. Young, who will talk on the trends of the times. The following morning L. Ward Bannister, lawyer, of Denver, will speak on "Miners' Rights to Subsurface Waters Encountered During Mining Operations."

Trends in social legislation will be considered at three round-table conferences. At the first of them, with Mr. Young presiding, the National Labor Board will be the topic. Discussion will be led by D. C. Jackling, Eugene McAuliffe, Paul Weir, R. C. Allen and W. Val De Camp, all well known.

Problems of the gold-mining industry will be discussed by Charles H. Segerstrom, of California, on Tuesday afternoon, Governor Morley Griswold of Nevada presiding. At this session Edward Snyder, of W. F. Snyder & Son, will talk on the distribution and utilization of power from Federal projects, in relation to the Western mineral industry, and F. A. Thompson, president of the Montana School of Mines, will speak on the benefits derived from United States Bureau of Mines experiment stations. A topic also on the program is that of the Federal policy toward Western mineral states.

Operating problems will be considered at a session at which Charles A. Chase, of Denver, will preside. Oscar A. Glaeser, of the State Compensation Insurance Fund of California, will talk on "Accident Prevention in Metal Mines."

"Unemployment Insurance and Workmen's Compensation" is to be the subject of the second round-table discussion. The leaders will be Herbert Jackson, of Pickands, Mather & Co.; G. Chester Brown, of the California Metal & Mineral Producers Association; and Ira L. Wright, of Silver City, N. M. Following this, at a session on "Taxation," with D. D. Moffat, of the Utah Copper Company, in the chair, Paul H. Hunt, of Park City, Utah, will speak on "Taxation of Mines and the Law of Diminishing Returns"; and A. W. Dickinson, of the Mining Congress, will discuss the problems presented by the new Revenue Law.

Such subjects as "The Tariff," "Strategic War Minerals," and "The New Deal," in relation to the metal industries and the West, are on Thursday morning's program. "The NRA" will be the topic of the third round-table discussion, with Messrs. Jackling, Weir, McAuliffe, and D. A. Callahan as leaders. The practical application of codes will be treated by R. C. Allen and Eugene McAuliffe subsequently. At the same session, W. S. Boyd will speak on "The Real Need for Centralized Cooperative Action."

At the annual banquet, concluding the meeting, W. E. Colby will preside.

One of the interesting features will be an equipment exposition. Special trips to points of local interest are to be arranged.

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East African Goldfields Proceeds With Development Plans

East African Goldfields is proceeding with the plan of development outlined by Amor F. Keene, consulting engineer. About 800 natives are at work on its Lupa Goldfields properties. Underground development is being carried ahead steadily with hand drills while awaiting arrival of machinery, and the permanent camp is in course of erection. Orders have been placed for machinery and equipment for shaft sinking, power plant, and compressor. The equipment is being sent forward as rapidly as possible, to get it to the property in September and October, the season of most favorable road transport conditions.

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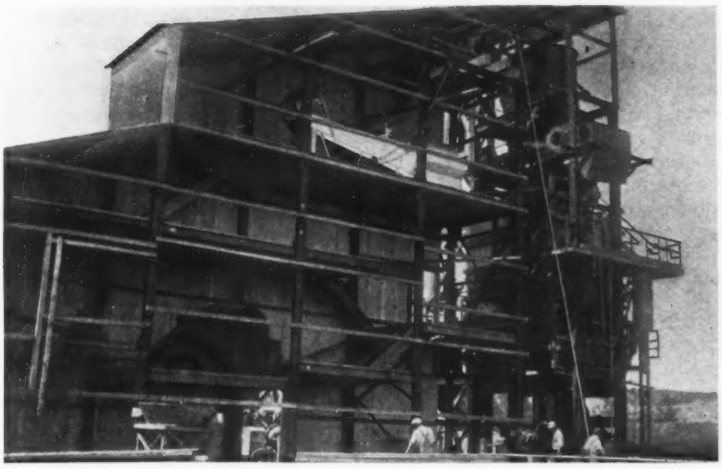
Kentan Gold Areas Takes Over African Holdings

Gold properties and concessions in Kenya, Tanganyika Territory, and Uganda, which Tanganyika Concessions, Zambesia Exploring, and Rhodesia-Katanga have been acquiring, prospecting, and developing for two or three years past, have been sold to Kentan Gold Areas, a company formed to acquire them. Kentan will continue the exploitation of the properties and float companies to take over and work such areas as may be proved of value.



Experimental plant of commercial size erected near Nashwauk, Minn., by Butler Bros. and the University of Minnesota at a cost of about $35,000. Crude hematite ore will be converted to magnetite by roasting and then concentrated in the mill section of the plant. The roasting section is seen at the right

Wide Interest in Western Gold Properties Continues

American Smelting & Refining Acquires the Old Octave Mine, in Arizona—Walker Mining Prepares to Resume Operations in Plumas County, in California—Utah Companies Announce Wage Increases

FLOW of capital from various sections of the country for the financing of Western gold-mining projects is apparently continuing at an undiminished rate. Included among the new operations of some of the larger companies is the rehabilitation of the old Octave mine, at Octave, Ariz., by American Smelting & Refining. Walker Mining, owing to the favorable price of gold, is preparing to reopen its copper-gold properties in Plumas County, Calif.

In Utah, Silver King Coalition Mines, Tintic Standard Mining, and United States Smelting, Refining & Mining raised their respective wage scales last month.

Discussions on the proposed zinc code were still in progress early this month. The deliberations between government officials and executives of the zinc industry are understood to have centered chiefly around certain wage features of the proposed code.

A proposed code for the iron-ore mining industry was presented at a public hearing in Washington before deputy Administrator Walter A. Janssen on Aug. 6. The code was submitted by R. C. Allen, of Cleveland, Ohio, chairman of the code committee of the industry. Mr. Allen said that the Lake Superior Iron Ore Association, which sponsored the code, comprised about 92 per cent of all iron-ore producers in the United States, and that the membership produced about 60 per cent of the total annual volume. The proposed code provides for an average 40-hr. week in each four- or five-week period, no one week to be longer than 48 hr. For purposes of administrating the code, the country is divided into two regions: Region No. 1, consisting of Minnesota, Michigan, and Wisconsin; and Region No. 2, comprising the remainder of the country and being itself subdivided into Eastern, Western, and Southern districts. Minimum hourly rates of pay are proposed as follows: 40c. in Region No. 1 and in the Western district of Region No. 2; 35c. in the Eastern district of Region No. 2; 27c. in Jefferson County, Ala., and 25c. in the remainder of the Southern district of Region No. 2.

A summary follows of the important developments in the various mining districts during the last month.

Arizona

United Vanadium Corporation is preparing to reopen its vanadium property, 20 miles south of Globe, which has been shut down for several years. The mill on the property will be placed in operation, and equipment, including an electric furnace, will be added that will make possible the production of ferrovanadium from mill concentrate. The company is also planning the erection of a 10-mile transmission line from the mine to the power line between Coolidge Dam and Hayden. Production has been contracted for by British and Swiss interests. The property covers 400 acres and is said to be the largest known deposit of vanadium in the United States. Herman Hertz, of Los Angeles, is general manager, and George Naddeo is mine superintendent.

A test plant of 10 tons' capacity is being erected by United Verde Extension Mining at its smelter at Clemenceau, to test ore from a ledge of gold-bearing quartz which has recently been discovered in the mine at Jerome. The lens extends from the 900-ft. to the 1,050-ft. level. Its strike is northwest, and it has been explored for a length of 200 ft. Its width varies from 2 to 13 ft. The ore is too siliceous to be treated in the converters.

White Beauty asbestos mine, near Young, is being worked by Mexican leasers who are sending the fiber on burros to the highway and then by truck to Globe. Another non-metallic property from which activity is reported is the Texas Canyon tungsten mine near Douglas, where the Texas Canyon Tungsten Company is installing a shaker sieve and ball mill.

The mill at the Best Bet mine, near Yucca, is being moved to Chloride and erected at the Pilgrim property. A pipe line is being laid from Mud Springs to the new mill site to supply water for both metallurgical and domestic purposes. The Best Bet was operated for a time last year by Congresswoman Isabella Greenway. At Oatman, the Western Apex has been added to the list of mines shipping to to Tom Reed mill.

The Wheeler-Howard bill which was recently passed by Congress provides for the reopening of the lands of the Papago Indian reservation to mineral location, and also provides that these lands can be withdrawn again only by Congressional action. The passage of this bill has been the direct cause of considerable prospecting and development work in the Casa Grande area. Charles A. Mitke has taken an option on the Vekol property, and J. B. Tenney, Tucson geologist, has taken over a small gold property a few miles southwest of Arivaca, from which he has made a shipment of high-grade ore. Gold Bell Mining, at its property north of Picacho peak, has sunk a two-compartment shaft to a depth of 200 ft., where a station has been cut and a crosscut driven to the vein. The shaft is to be deepened an additional 200 ft. before more drifting is done. Bartlett and Darley have made a small shipment from a claim near the Indian village of Santa Rosa.

American Smelting & Refining has acquired the Octave mine, at Octave, an old gold-mining district, and is remodeling the mill building on the prop-

erty preparatory to installing a flotation mill of 75 tons' capacity. At the Comstock-Dexter mine, also in Yavapai County 33 miles northwest of Hillside, a new 150-hp. diesel engine and generator has been installed to furnish power for hoisting and air compression. A crew of 25 men, on three shifts, is engaged in sinking a 400-ft. shaft. The West property, near Payson, is reported sold to F. G. Wright, of New York.

Utah

What promises to be the making of a new mine, and perhaps the making of a new district in the Park City area, has been discovered in the property of Park City Utah Mines, 2 miles southwest of Keetley. The strike, which is pronounced to be the most significant in recent years of Park City mining, lies in the Wasatch formation below the Weber quartzite in the Wasatch east-west fissure.

Considerable work had been done by Park City Utah Mines, under the leadership of George W. Lambourne, several years ago, from the workings of the Park Utah Mine. Recently, the company decided to prospect the higher formations in its property from the Star of Utah tunnel in the property of New Park Mining, at a point about 4,000 ft. from the portal. A short crosscut was driven from the Star of Utah tunnel into Park City Utah Mines ground, where the Wasatch fissure was struck and followed west. At the last report from the property, the ore had been followed for more than 50 ft. The width of the ore has not been determined by a crosscut, but it is estimated to have a width of 25 ft. where a north-south crossbreak intersects the Wasatch fissure. One of the remarkable features of the discovery is the high gold content of the ore, which also contains silver, lead, and zinc.

Park City Utah Mines was organized in 1928 by Mr. Lambourne to develop the old Liberty and a number of other groups in the East Park City district, adjoining the Naildriver and the Park Utah mine, one of the large Park City producers. Operations in the property are being directed by Oscar N. Friendly, assistant manager, and Paul H. Hunt, superintendent. Claims of the company are traversed for over a mile by the Wasatch fissure.

This development will probably have an important bearing on the future of New Park Mining, comprised of the Star of Utah, the Park Galena, the Park Bingham, and other groups, headed by W. H. H. Kranmer, as manager. The Wasatch fissure, now proved to be ore bearing, is believed to strike and dip into New Park Mining ground.

Work of New Park Mining, when the Lambourne interests started their prospecting, was transferred from the Star of Utah tunnel to the Mayflower deep tunnel. Now the company reports that the face of the tunnel at a distance of 4,000 ft. from the portal is cutting the Wasatch formation. The downward continuation of the Park Bingham orebody should be intersected soon. Damage by a fire that destroyed the surface plant at the property has been repaired and the machinery put in condition for operation again.

Leasers operating the property of Utah Ophir Mines have opened a promising orebody in the property, 9 miles southwest of Stockton. In drifting on the fissure 20 ft., J. F. Featherstone, manager, reports 70 tons of ore have been shipped that netted returns of $1,025.47.

The ore, found on a lease given to C. J. Frazier, Harold S. Gilliespie, and Harold Daly, of Tooele, proves the value of an extensive geologic survey conducted in 1930 indicating that the great orebody, highly productive in the Kearsarge and Mono mines, had been dropped by a block fault 750 ft. vertically and overthrust south a considerable distance.

The ore lies in the "great" blue limestone formation beneath the Long Trail shale member in a northwest-southeast fissure. On the strength of the favorable development, the company advanced money to build 1¾ miles of road so that the ore can be economically hauled to the smelter.

Rebuilding of the surface plant of Park City Development, at Park City, is well under way, and early this month, A. L. Hurley, manager, hopes to have the damage, done by forest fire, repaired in full and shipments resumed.

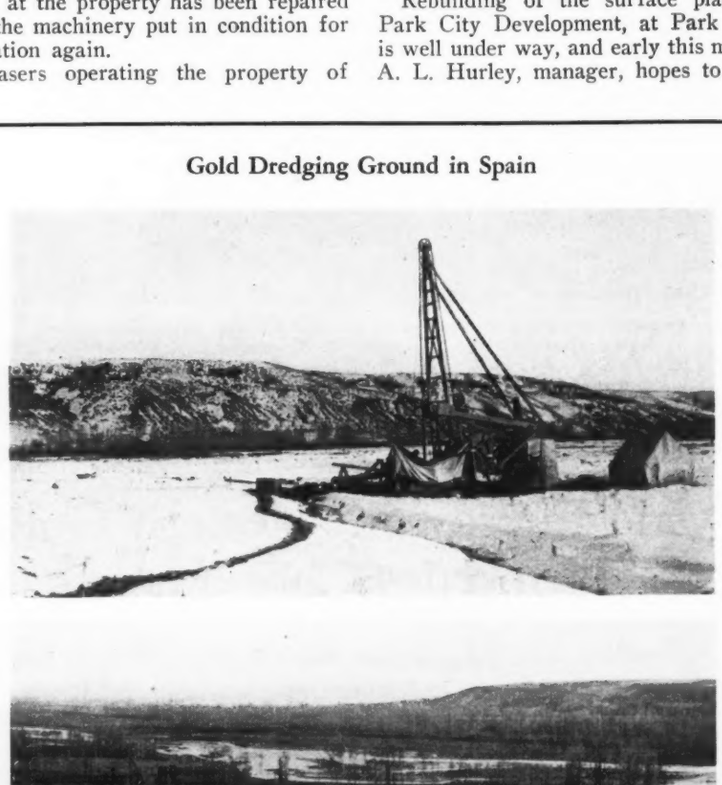
Sinking in the Apex Standard shaft is nearing the 1,100 level, where laterals will be started toward ore objectives. On the 1,000 level, a crosscut is being advanced to a fissure that carried substantial quantity of gold on upper levels.

Little May Mining is driving a tunnel at its Raft River property, in Box Elder County, and some ore is being taken out.

Utah Central Mining, in its Drum district property, 35 miles west of Delta, is driving a crosscut on the 520 level to intersect two of the main mineralized fissures of the district.

Sinking of the Eureka Lilly shaft, in the south end of the Chief Consoli-

Gold Dredging Ground in Spain



Above—Testing dredging ground with a Keystone drill at Villaroquel, near Leon, Spain. Below—Part of the gold-dredging area held by Dome Mining Corporation along the Orbigo River in the Province of Leon. These photographs are reproduced through the courtesy of R. S. Botsford

dated property, at Eureka, has reached a depth of 900 ft. where the upper Ophir formation is being entered. The company expects to sink to the 1,300 level. Leasers are shipping from the northern end of the property, where work is being done on the 1,000 level through the North Lily shaft.

Activity is on the increase in Beaver county camps. King David Mining is driving the north drift on the 1,100 level toward north-south fissures through a highly mineralized formation. Shipments are being made, according to reports, from the Honey Boy mine, in the Bradshaw district. The Lincoln mine, adjoining the Cave mine, is being reopened. Beaver Gold & Copper is shipping some ore. Development is being carried on in the Frisco Silver-Lead property.

Wages at the Silver King Coalition Mines, effective Sept. 1, were increased 50c. a shift, raising the scale of machine men and first class miners to $5 a shift and that of muckers to $4.50. Tintic Standard Mining also increased its wages 50c. a shift, making the base pay for miners $5.25 a shift and that for muckers, $4.75. Effective the same date, United States Smelting, Refining & Mining raised its wage scale for mine and smelter employees 25 and 50c. a day respectively. International Smelting also raised its scale 25c. a day, to bring it to a parity with the new Utah scale.

Superior Gold Mines is increasing the capacity of its flotation mill, 14 miles west of Modena, in Iron County, so that 130 tons of ore can be treated daily. A high-grade orebody has been followed on its dip for a depth of 420 ft. Stoping width of the ore averages from 6 to 14 ft. wide. A new 150-hp. diesel engine has been installed and also a 5x6 ft. ball mill. C. C. Cushwa is engineer and mine superintendent; W. W. Showalter, mill superintendent; and H. M. Hartmann, consulting engineer. E. G. Frawley, of Salt Lake City, is secretary of the company.

Minnesota

The Vermilion Range Old Settlers Association met on July 30 at the Soudan mine, near Tower, to dedicate a monument to commemorate the 50th year of iron ore shipments from the Vermilion range. The monument has a base of local rock on which is mounted a 5½-ft. shaft of iron ore streaked with jasper, taken from the Soudan mine. An attached bronze plate presents the historical details. The day was perfect and zest was added to the occasion by the presiding of W. P. Chinn, of Duluth, general manager of Pickands, Mather Company, who was working at the Soudan mine when the first trainload of iron ore was shipped to Two Harbors in 1884. Several thousand were present to enjoy the ceremonies.

A fire was started in the roasting stack of the iron-ore conversion plant near Nashwauk about Aug. 1, and test runs will soon start. This is the most elaborate test plant that has been installed on the Mesabi range for converting hematite to magnetite ore and concentrating to commercial grade. It is attracting much interest among mine operators.

Nevada

Mountain City Copper recently purchased the holdings of Tintic Standard Mining in the Cope mining district at Mountain City. Claims purchased almost surround Mountain City Copper's ground, where International Smelting has sunk a triple compartment shaft 500 ft. deep and is drifting to cut the bonanza copper orebody opened up in the old property. The price paid for the claims was $47,500 and 47,500 shares of Mountain City Copper stock. Tintic Standard, through a subsidiary, still holds the Mayflower group adjoining the Mountain City Copper property.

The new 75-ton cyanide plant of the Hartford Mining, between Virginia City and Silver City, was put into production on Aug. 1. The mill, which was furnished and installed by the Western Machinery Company, consists of primary and secondary grinding units, agitators, thickeners, filters, all electrically and individually driven. Hartford Mining is a Nevada corporation. George Drysdale, of Virginia City, is general manager, and his associates are Edward Gunderson and Harold Hansen, of San Francisco.

California

Goldfields American Development has started unwatering the 1,670-ft. shaft of the Union mine, near Placerville, as a preliminary to reopening the old producer, which has been idle for almost 30 years. L. Wills, mine superintendent, is in charge of operations.

According to reports from Jackson, the three principal gold producers in Amador County, the Argonaut, Kennedy, and Central Eureka, recently ordered a pay increase of 50c. a day, effective Aug. 15.

The Ready Bullion mine, on Round Lake, in southern Plumas County, is being rehabilitated and equipped for early production. Equipment in course of erection includes electrically operated hoisting and compressor machinery, a 125-ton milling plant, and a diesel power plant. W. H. Webber is general manager of the company.

Walker Mining, a subsidiary of Anaconda Copper, is said to be preparing for early resumption of operations at its copper-gold properties in Plumas County. Activities were discontinued about three years ago because of depressed copper prices, but the present price of gold is expected to make operations profitable.

The new 150-ton flotation mill of Cardinal Gold Mining, built under contract by Eastern Iron & Metal, Salt Lake City, Utah, to replace the plant recently destroyed by fire, has been completed, and milling operations have been started, according to word received from Bishop. Cardinal Gold is controlled by New York and California interests, with W. V. DeCamp, general manager, in charge of operations.

After a review this month of development results at the Smartsville property of Gold Exploration, a subsidiary of Tintic Standard Mining, a decision will be made on the installation of a 150-ton sluicing plant. Existence of a commercial gold placer channel, only a small part of which had been worked previously, has been proved, according to James W. Wade, general manager of the company. Since the property was acquired in August, 1933, more than 900 ft. of old workings have been opened up and a new double compartment 440-ft. incline shaft has been sunk on the gravel to bedrock in virgin territory. This development has proved the extension of the channel 200 ft. beyond the old workings. In the new section of the mine, the channel has been exposed for a length of 100 ft., with a width of 150 ft. and a thickness of 9 ft. The property of the company embraces 1,900 ft. along the channel, most of which is believed to be virgin. Operations are in charge of General Manager Wade; J. M. Snow, geologist; and M. D. Payne, chief engineer.

H. R. Plate and associates have taken under option the Young America, Mountain, Euclid, and Phoenix mines, in the Sierra City district. Exploration and development of these old properties are being carried on. The consolidation of these mines covers about four miles on the strike of a large low-grade gold-vein structure.

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Much Prospecting in the Congo

Mineral resources of the Belgian Congo are receiving increased attention. Prospecting activities are greater than for many years. During the first half of last year 273 new prospecting concessions were granted by Compagnie de Chemins de fer des Grand Lacs, these bringing the total granted up to 2,974. The minerals and metals sought include gold, tin, columbite, iron, copper, wolfram, and niobium. Tin production is increasing rapidly, the exports of Congo cassiterite from Matadi having totaled 1,833 metric tons for the first five months of this year, against only 847 tons a year ago.

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New Sulphur Plant in Mexico

The Refineria de Azufre Guadalupe, a sulphur refinery with a maximum daily capacity of 900 metric tons, owned by Mexican interests, has begun operations at Arista, San Luis Potosi.

Surface plant at the property of Falconbridge Nickel Mines, Ltd., 13 miles northeast of Sudbury, Ontario, Canada. Ore is treated by flotation for the removal of barren material, with no selective action on the sulphides being sought. Converter matte from the smelter is shipped to the company's refinery at Kristiansand, Norway

Canada's Mineral Output Reflects Economic Improvement

CANADA'S mineral output for the first half of this year reflects two favorable aspects of the Dominion's economic life. The metals, which in the main are exported and provide a considerable part of the country's credit abroad, have expanded markedly in volume and value. Coal, iron and steel, and the non-metallic minerals, consumed mainly within the country, show a more moderate increase, which marks the steady improvement in manufacturing. Building materials have increased somewhat but are still at a low ebb.

Gold, at 1.4 million ounces for the half-year, is slightly below the corresponding period of last year. Although over a score of new gold mills are in operation, their total output is small compared with that of the eight or ten larger producers, and the latter have gradually reduced the grade of their mill feed as the value of gold increased. The Federal tax on the dividend-paying gold mines, which aggregates about $10,000,000 annually, has had no visible effect on either the operation of the mines or the payment of dividends. Silver, at 7.5 million ounces for the six months, is about at the same level as last year. Though the present price has resulted in several of the old silver mines being opened in a small way, there is little likelihood of any appreciable increase during the remainder of the year.

The base metals have advanced markedly in output, nickel, at 62 million pounds for the half-year, being 3½ times as much as in the first half of 1933; zinc, at 142 million pounds, being double, and lead, at 155 million pounds, being 20 per cent ahead of last year.

Quebec

A large part of the exploration for gold in the province this year is being conducted on occurrences in the granodiorite that are characteristic of the east end of the gold belt. Siscoe, the pioneer in this area, is now treating 330 tons a day and is installing equipment for hand picking, which is expected to take out 15 per cent of barren rock. At the nearby Greene-Stabell and Sullivan mines, whose productive veins are in the volcanic formation, drifts to the contact with the granodiorite are being made in the expectation of finding there productive vein systems similar to that of Siscoe. At the Lamaque property of Teck-Hughes, a few miles to the east, a sufficient concentration of gold in the mile-long gold-bearing zone has been found to warrant plans for a 200-ton mill, whose construction has been commenced. Dome is getting encouraging results on the adjoining Sigma property of similar character. The Bussiéres mine, 10 miles to the east, continues to operate steadily.

British Columbia

Less activity prevailed in the Cariboo during the first half of the current year than in the same period of 1933, but steady production has been maintained by Cariboo Gold Quartz. At this property, every effort is being made to increase production and developments are being directed chiefly toward this end.

The B.R.X. shaft, in the Bridge River area, has reached its objective depth, and a crosscut is being run into the footwall to explore the vein indicated by the diamond-drill hole. This drill hole was intersected by the shaft, so no uncertainty exists in regard to the direction or length of the crosscut that will be required to reach the point at which the values were indicated by the drill.

Extremely interesting developments are reported from the Sheep Creek camp, in the Nelson district. Chief among these are the results which have been obtained by Sheep Creek Gold Mines in the renewed development of the Queen mine, the old workings of which were unwatered early in the year.

Ontario

Hollinger Consolidated is installing a mining plant at its gold property in Hislop Township, east of Ramore, on the northern gold belt in which lies the Porcupine camp. A campaign of diamond drilling has indicated a large body of ore of medium or low grade. McIntyre, Premier Gold, Mining Corporation, and other companies have acquired ground in the vicinity. Rock outcrops are infrequent in this locality, and prospecting is correspondingly difficult.

A development rather unusual in Ontario is that of North Shores Gold Mines near Schreiber, on the shore of Lake Superior. Narrow, high-grade veins are found in the high bluffs along the shore, and a substantial tonnage has been developed by means of an adit. Equipment for a 25-ton mill and diesel power plant has been delivered at the site by steamship. R. N. Palmer has developed the property.

Northwest Territories

The Hottah Lake pitchblende showings south of Great Bear Lake have been opened by shallow pits, which indicate a good volume of the mineral, though the lenses are erratic in size and occurrence. The first test shipment to Ottawa was rather low in uranium oxide, but the pitchblende now exposed to view is apparently of high grade, though this can be proved only by a further test shipment now on the way.

Manitoba

J. F. Wright, late of the Geological Survey of Canada, has commenced the development of a large, low-grade gold showing in the Herb Lake section, known as the Apex deposit, for Fifty-Three Syndicate, of Winnipeg. Surface sampling indicates a deposit 800 ft. in length and from 30 to 150 ft. wide.

Gunnar Gold has a shaft-sinking record that is worth noting. The three-compartment shaft, 6x16 ft. outside the timbers, was sunk to 524 ft. in 95 working days at a cost of a little under $50 a foot.

NEWS FROM WASHINGTON

By Special Correspondent

TWO MONTHS of confused, distorted economics lie ahead of the mining industry. Interpretation of current events on the basis of spot news or normal reasoning leads to unsound conclusions. Washington, more potent than ever in business affairs, is not proceeding along even customary political lines. All of this makes executive decision the more difficult.

Organization of the American Liberty League is perhaps one of the best indications of the confused situation which confronts every enterprise that mines, imports, markets, or processes minerals. Avowedly an advocate of constitutional government, it has been viewed by many as an opponent of the New Deal. That was apparently not its original function, but may become its outstanding operating purpose. It crystallizes for the first time openly the seething revolt which has underlain official Washington for months.

Apparently the President has thrown down the gauntlet to League organizers. He seeks to make the New Deal spokesman of human rights and tries to hang about the neck of the new organization a badge of property rights. If such controversy eventuates in the fall elections as a major campaign issue, every branch of business, perhaps mining more than any other, will be confronted with a serious threat.

Mining Loans

No loans by R.F.C. for mining enterprise had been made up to the end of August. This result was a natural consequence of the numerous policy and procedure decisions which were required before even establishing application forms. Hundreds of requests for applications have come to the Corporation, and a corresponding number of requests for loans are expected.

General requirements to be met by those seeking R.F.C. loans are defined in Circular No. 14, issued in July (*E&MJ* August, 1934, p. 375). Applitions must be made on forms that were not completed until mid-August. Up to the end of August practically no applications had been returned in sufficiently complete form to permit action by the board of directors, even if financial and engineering investigations could have been completed.

Expectations are that former Senator Tasker Oddie will assist materially in handling these mining matters, as he serves as special representative on the West Coast. Supervision in Washington is under Director Charles B. Henderson, and active work is definitely organized in the mining division, which, in effect, has succeeded the executive self-liquidating division of the Corporation.

Critics have charged not only that the work is proceeding slowly but also that plans are such as practically to preclude extensive or frequent grant of money to the mining industry. The latter charge is based on the two major requirements for securing such loans: First, it must be shown that the would-be borrower is not able to secure the desired funds through normal banking channels; secondly, acceptable collateral must be furnished to protect the government against loss. Under these circumstances, experience with other industries shows already that those who wish to borrow, and who have adequate security, usually cannot prove inability to get money through banking channels. Thus, automatically, the policy which has been fixed limits the number who may become successful candidates for official aid under the loan procedure.

Code Police

Official judgment has apparently at last accepted the idea that policing codes is not a job which can be accomplished through NRA. Hence even the plan for complete reorganization, with substitution of a board for the one-man dictatorship, has not prevented active enforcement efforts through other channels. The judicial, as well as the conciliation, problems associated with labor difficulty are rapidly being assimilated by the National Labor Relations Board, which is working intimately with the Labor Department. That affiliation indicates that the President is restoring to Miss Perkins' domain the labor adjustment responsibilities which for a time were, at least theoretically, under General Johnson.

Trade practice code enforcement has definitely begun at the Federal Trade Commission, and modestly in the courts. One Florida ice firm is being investigated by the Commission for alleged increase of ice-making capacity without permit or authorization from the Code Authority. In another precedent-making case, certain rubber manufacturers are charged with illegal collusion and opposition to code affairs. These two cases, and other minor evidences, strengthen the belief in Washington that ultimately the Federal Trade Commission will have reassigned to it trade practice matters, as in the Hoover regime.

Some real basis for judgment in these matters will be furnished when the President finds a basis for settling the bitter controversy which has been raging during the past month between General Johnson on one side and Secretary Perkins and Donald Richberg on the other. Out of this controversy will ultimately grow a board management of NRA, either as such or under a revitalized Trade Commission.

The anti-General faction in the controversy has, however, apparently forgotten that vigorous open opposition to an official is not now the successful method for changing personnel subject to Presidential appointment. Roosevelt has repeatedly shown that he rarely fires a man who is under fire. This perhaps more than anything else explains why General Johnson has been so long retained after the time when almost every faction in Washington believes that his period of maximum usefulness has passed.

Planning

Extensive reorganization of the planning agencies of Washington under the Cabinet Committee, which succeeded the National Planning Board, has not significantly affected the work of subordinate agencies that deal with mineral policy. Professor C. K. Leith, continuing as vice-chairman of this activity, still reports to Secretary Ickes and supervises in a general way the subordinate work of the commodity committees.

None of the mineral groups has yet submitted final recommendations, nor allowed any official announcement of proceedings. Some influence of these commodities on current trade-treaty negotiation has doubtless been exerted; but the major objective continues: long-time planning rather than immediate result in negotiation. Coordination of ideas is, however, assured by the fact that almost identical personnel (all governmental) serves in the two types of activity.

Mines Director

John Wellington Finch was sworn in as Director of the Bureau of Mines on Aug. 28, thus terminating a series of unhappy incidents in the recent history of the Bureau. Washington comment is varied. The hope is expressed that Dr. Finch will be treated with more political consideration than was shown his predecessor, Dr. Scott Turner. The latter resigned July 6 after a year of uncertainty of tenure of office, needlessly offensive and arbitrary treatment by his superiors, and official bungling in the appointment of his successor (*E&MJ* August, 1934, p. 337). Political repercussions are expected, particularly in view of the President's announced policy of keeping technical bureaus out of the patronage class.

Non-political comment on Dr. Finch's appointment reveals two schools of thought in Washington. Spokesmen of the mineral economists, approving the selection, have been jubilant. This

group sees in the new Director an outstanding spokesman of mineral economics, who it is expected will greatly strengthen that type of activity in the Bureau. Mining engineer spokesmen have not been so well pleased. They represent the group who wish the Bureau to be nationalistic, pro-tariff, technologic in nature. Their opposition to the new Director was not on grounds of capability, but rather on the score that his point of view is too strongly international to suit their taste.

Internationalism

Trade in minerals is definitely a factor in current negotiations of the State Department as a part of the formulation of new bilateral agreements with Latin American nations. Agenda committees are working on at least ten such trade agreements within the State Department. But secrecy continues to shroud all proceedings. Even at the end of August the Department refused to disclose officially with what nations agreements are in preparation or contemplated. Up to that time only the Cuban treaty had been announced.

Those who have been closely acquainted with official psychology were not surprised to find in the Cuban tariff announcements no provision for a new tariff on manganese (*E&MJ*, August, 1934, p. 376). That document clearly was the result of effort to give relief in Cuba for sugar-producing labor, and for the United States a renewed opportunity to sell the products of agriculture. Thus, with one stroke, the President attempted to eliminate the threat of further armed revolution in the island neighbor, and sought a further agricultural relief for United States nationals.

Protection of Cuban manganese, or repudiation of the United States industry, is not a logical interpretation of the failure to impose the requested tariff on this mineral. It is much nearer the truth to conclude that manganese was of far too little importance in this instance to be regarded as a real issue, despite the clamor about it.

Manganese will have become a significant consideration if and when a Russian settlement becomes feasible. It is not so likely to be an outstanding consideration in the Brazilian treaty, although trade negotiations with that nation are already apparently well advanced.

Strikes

The outstanding strike of the past month affecting metals and minerals was that suffered by Aluminum Company of America. In this instance circumstances have been much complicated by the very evident bitterness of all New Dealers toward anything that savors of Mellon control. Even without that element, a protracted strike might have been expected.

Washington has noted with particular interest the announcement of Alcoa officials that they have on hand huge stocks of pig aluminum. This was interpreted as a thinly veiled threat to the strikers' management. Some even believe that the company has welcomed labor difficulty in its reduction plants as affording an opportunity to cease operations and thus reduce these pig stocks to more nearly normal proportions. Whatever motives may have been involved, the reported settlement robs them of all importance.

Observers viewing the labor troubles of Montana copper mines point out an analogous situation there. Some critics even go so far as to say that it has been a definite advantage to Anaconda to draw its quota copper from stock, instead of continuing new production.

Continually reiterated forecasts of important policy decisions from National Labor Relations Board did not materialize in any epoch-making announcements during August. This delay, excused during July by the President's absence, has somewhat mystified Washington. Presumably, however, it merely reflects the Roosevelt policy of avoiding issues until definitely pressed for decision.

The real labor test next expected is that which centers in the cotton textile strike. That an industry which has been held up by the Administration as a model for prompt codification should so fall from grace creates a very real difficulty for the President. On Sept. 5 he appointed Raymond V. Ingersoll, President of the Borough of Brooklyn; John G. Winant, Governor of New Hampshire, and Marion Smith, chairman of the Atlanta Regional Labor Board, to act as a board of mediation in seeking a settlement of the strike.

Gold and Silver

Nationalization of silver during August created much more stir than was expected or intended by the Administration. A definite plan had been adopted weeks earlier to take such step when the price of silver advanced to the desired level. This price was reached just below 50c., and the long-ready Executive orders were, therefore, promulgated. This action represented no new policy of either the President or the Treasury Department. The inflation significance was grossly exaggerated in the market.

Washington now believes that any further price adjustments on silver need not be expected soon, probably not before the fall election, but certainly not until after the September financing has either succeeded or supplemental aids to Federal credit have been set up. In this situation the President sails between two dangerous political rocks. On the one hand, failure of employment relief measures presses for further goods-price inflation. On the other hand, is the urgent political necessity for deferring until after November too great advance in the cost of living.

Because the President rightly fears this latter possibility, those best informed in Washington forecast no further devaluation of the dollar in terms of gold until December, at the earliest. Somewhat analogous reasoning leads to the belief that domestic silver will get no further favors at all. This conclusion, however, neglects the fact that Congress reconvenes in January, and that means for exerting silver-bloc pressure on the President will then again be at hand.

Tin Inquiry

A preliminary report to the House of Representatives Tin Investigation Committee was made Aug. 15 by Roy Veach (*E&MJ* August, 1934, p. 375), who had been loaned by the State Department as an economic adviser. After executive session of the committee announcement was made that the committee had authorized the appointment of a technical adviser and the conduct of an investigation extending over the next two or three months to develop full information on all phases of tin supply and requirements.

Daily press dispatches gave incorrect alarmist interpretations of Mr. Veach's report. He was incorrectly quoted as saying that the country had only two months' tin supply on hand, and that the domestic detinning industry had been ruined by Japanese purchases of tin-plate scrap. Neither statement was properly credited to him, nor is either statement correct as to fact.

The committee is announcing a selection of technical adviser early in this month. It is not expected to meet again until late in November, when its specialist will report. At that time public hearings will probably be held, at which all interested divisions of the tin industry will be asked to appear. Before convening of Congress in January, an appropriate report, presumably including legislation, will be formulated.

Recovery

No industries are more importantly affected by lack of progress in construction than are mining and metals. Hence the continued delay in securing real action on housing constitutes a major disappointment in Washington. Thoroughly impartial and competent inquiry discloses that, even with huge Federal spending, the use of public funds on construction today is about one-third below normal. *Business Week* states that the years 1931, 1932, 1933, and 1934 are the only ones since the 1921 depression when public works spending has been as low as two billion. This is contrary to general understanding. Great confusion has arisen from the fact that Federal spending has been very high and conspicuous, but minor jurisdictions have been able to apply almost none of their own money to the customary activities in this field.

A vigorous campaign for home repair and modernization is planned for the fall, to start in September.

New Australasian Mining Projects Chiefly in Gold Areas

SINCE the Mount Morgan mine recommenced operations about two years ago the output totals 733 tons of copper and 44,890 oz. of gold, valued in all at £386,000. The company is milling 3,500 tons weekly, the assay being 6.5 dwt. gold and 0.5 per cent copper. At present the company is mining by open-cutting a block containing 664,270 tons assaying about 6.5 dwt. gold and 0.91 per cent copper. If gold maintains its present price the remainder of 8,000,000 tons assaying about 4.37 dwt. gold and 1.72 per cent copper will probably be treated at a profit. The treatment involves fine grinding, flotation, filtering, and drying. The concentrate is exported.

Western Australia

Gold Mines of Australia has arranged for a geophysical survey to be carried out on extensive deep lead (buried auriferous gravel) systems in the Allendale district. Electrical and magnetometric methods will be used, first on bored ground so that methods can be developed and the equipment standardized. Should a satisfactory method be evolved, the mapping of the paths of the ancient river channels will be simplified greatly.

Mount Magnet Gold Mines, which is developing the Hill 60 miles at Mount Magnet, is to install a cyanide plant to treat 150 tons of oxidized ore daily.

Rich ore is being won at the Norseman mine, Norseman, the yield in June being £10,700 (Australian) from 2,313 tons. The mill consists of a twenty-head battery and cyanide section.

A new process of gold-ore treatment has been developed and patented by Victor Edquist, superintendent of the Sons of Gwalia mine. The process embodies three stages: first, the solution of the gold and silver by cyanide solution of standard strength; second, the precipitation of the dissolved gold by the addition of a precipitant such as finely divided charcoal, and third, the removal of the precipitated gold by treatment of the pulp in standard flotation equipment. The process has not yet been tried on a large scale, and complete details are awaited.

Tasmania

The Aberfoyle tin-wolfram mine, at Storey's Creek, treated 10,234 tons during the year ended June 30, 1934, for a yield of 198.25 tons of high-grade tin concentrate, 215 tons of "seconds" concentrate, and 9.5 tons of wolfram concentrate.

During recent months, operations at Mount Lyell have been seriously hampered by water shortage. As a result, for the quarter ended June 30, the company milled only 39,826 tons, instead of 120,000 tons as usual. The present grade is about 2.7 per cent copper, but the future of the field depends on the profitable treatment of material containing 2 per cent copper.

New Guinea

During June, Bululo Gold Dredging treated, with three dredges, 688,700 cu.yd. for a bullion yield of 14,106 oz. containing 9,602 oz. of fine gold. The working profit was £60,580. The yield was the highest to date. A fourth dredge will commence operations at the end of the year. No announcement has been made as yet in regard to the treatment of the deeper layer of auriferous wash.

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Mexican Miners Present Gifts to Senator Pittman

Mexican silver miners tendered Senator Key Pittman two handsome testimonials when he visited Nogales, Sonora, on Aug. 18 at the invitation of the state government and silver producers in that country. The testimonials, presented by Governor Rodolfo Elias Calles of Sonora, were a reproduction of the famous Aztec calendar stone and a silver testimonial plaque. Fifteen kilograms of silver were used in fashioning the calendar, which is circular and has a circumference of 55 cm. The plaque bears the legend: "Homage to the Apostle of Silver, Hon. Key Pittman, Senator of the United States of America. Tendered by Señor Rodolfo Elias Calles, Governor of the State of Sonora, in representation of the silver miners of Mexico, Nogales, Sonora, Mex., August 18, 1934."

Construction of a 150-ton flotation plant is being completed by Southwestern Exploration at its Cabrita mine, near Santa Barbara, Chihuahua. . . . Cia. Minera del Monte is building a 30-ton flotation plant at Tetinac, Guerrero. Cia. Minera Diversidad is preparing its La Veronica, Viachachi, and San Juan mines, Taviche municipality, Oaxaca, for early operation. . . . Work has started on the gold-silver tracts of Harrigan, Silver Hill, La Mexicana, Tyra, La Reyna, and San Carlos, Rosario municipality, Sinaloa, by a company headed by James Cogswell.

Fundos Mineras Pacheco expects to have in operation early this month a 20-ton ball mill it constructed on its gold-silver property in the Zacualpan district, Mexico. A shaft has been sunk 72 meters and a tunnel to connect with it has been driven 148 meters. . . . Cia. Minas de Oro has commenced working three mineral tracts in the El Favor zone, Concordia district, Sinaloa . . . After ten years of idleness, work has been resumed in the Savonarola mine, Rosales municipality, Chihuahua. . . . Cia. Minera y Explotadora del Amparo has put into operation a concentration plant of 40 ton daily capacity which it built at Monte de San Nicolas, near Guanajuato City, Guanajuato, to treat ore from its mines. . . . Cia. Minera de Nueva Luz has resumed work in the Nueva Luz mine, Mazatlan municipality, Sinaloa, and is repairing a flotation plant of 15 tons' capacity daily, to treat ore from that mine. . . . The Salvador tract, Mineral de El Sabinal, Ascencion municipality, Chihuahua, is being worked by Salvador Franco Urias.

Small hydrotator treating tailing at the Canisteo mine, near Coleraine, Minn. Use of the hydrotator (see *E.&M.J.*, June, 1934, p. 284) is being adopted at the new washing plant that the Corrigan McKinney Company is erecting at its St. Paul mine, near Keewatin, Minn.

PERSONAL ITEMS

A. C. Brinker is manager of East African Goldfields, Ltd., in Tanganyika Territory.

Frank C. Mulford is now with the Southern Exploration Company at Humboldt, Ariz.

Sydney H. Ball, of the firm of Rogers, Mayer & Ball, is in Ontario on professional business.

E. L. James has been appointed manager of the Wavic mine, at Higginsville, Western Australia.

Thomas K. Scott, mining engineer, recently opened a consulting office in the First National Bank Building in Boulder, Colo.

Forest Rutherford, consulting engineer, of New York, has returned to the city after a professional trip to the West.

Merle H. Guise has gone to Georgetown, British Guiana, to inspect a number of gold-placer properties in that country.

Hyman Friedman, formerly on the Miami Copper underground engineering staff, is now employed at the Philadelphia Mint.

Jack Coolbaugh is now operating superintendent of the Clear Creek-Gilpin Company's new custom mill at Idaho Springs, Colo.

Oliver H. Coles, for a number of years a chemist at the International smelter at Inspiration, Ariz., has accepted a position at the New York Mint.

E. R. Pembroke, of Salt Lake City, Utah, has resigned the management of the Miners Gold Mining Company at Midas, Nev.

H. C. Enos, of Chatsworth, Calif., after completing examinations near Lead, S. D., flew to Washington and returned to Los Angeles.

Hugh K. Lancaster is assaying for the Paracale Mining Company which is developing a prospect near Paracale, Camarina Norte, P. I.

Herbert C. Jennison has been appointed technical manager of the American Brass Company. He succeeds the late Willaim H. Bassett.

Ian Shanks, of the mine staff of Wiluna Gold Mines, Ltd., has accepted the position of manager of the Hill 50 mine, Mount Magnet, Western Australia.

Donald Gill returned to London from Australia recently and later flew to Northern Rhodesia, where he went to become manager of Luiri Gold Areas, Ltd.

W. Lee Heidenreich has been appointed manager of McMillan Gold Mines, in the Sudbury district, Ontario, where a 100-ton mill has just been put in operation.

J. W. Littleford, superintendent of the Roan Antelope concentrator, has returned to the property. His assistant, **Pete Schaefer,** will take advantage of a leave of absence to visit America.

Alan Bateman, professor of economic geology at Yale University, recently made a professional trip to northern Ontario, and later was one of a group of seven amateurs to sail a 62-ft. schooner yacht across the Atlantic via Bermuda, Azores, Spain, and Southampton.

Frederick MacCoy, Berkeley, Calif., has been appointed consulting engineer for the Salacot Mining Company and has sailed from San Francisco to the Philippines to inspect the property.

J. Ludgate is resident manager and **W. A. Thomas** mill superintendent of the Young-Davidson gold mine, at Matachewan, Ontario, Hollinger's low-grade, low-cost subsidiary.

James H. McGraw, chairman of the board of the McGraw-Hill Publishing Company, has been appointed a member of the Advisory Committee of the American Standards Association.

S. J. Clausen, Jr., engineer in charge of exploration activities in the Western States for Howe Sound Company, has moved his headquarters from 100 Court St. to 237 Clay St., Reno, Nev.

Foster S. Naething, vice-president and managing director of Mammoth-St. Anthony, Ltd., has moved to Tucson, Ariz., to take active charge of the operations of the company.

John G. Baragwanath has been elected a director of East African Goldfields, Ltd., which is developing properties in the Lupa gold field of Tanganyika Territory, East Africa. The company's offices are at Dar-es-Salaam.

Ira B. Joralemon, of San Francisco, and **Dean Ernest N. Patty,** of Fairbanks, Alaska, accompanied **General McRae,** of Vancouver, on an extensive mine-examination trip through Alaska, this summer.

Arthur D. Storke has returned to London from a visit to the Northern Rhodesia properties of the companies of which he is managing director—Roan Antelope, Mufulira Copper, and Rhodesian Selection Trust.

K. S. Twitchell recently made a trip of inspection to some mines in the Sudan. He reports high-grade ore at the Wadi Oyo mine, at a depth of 462 ft.; also that development work is proceeding at the Rahag Hindib property.

W. R. Lindsay has resigned as general superintendent of Granby Consolidated Mining, Smelting & Power Company, Ltd., at Anyox, B. C., and has accepted the position of manager of Reno Gold Mines, Ltd., at Salmo, B. C.

William A. Neill, for eighteen years associated with The Dorr Company in its mechanical engineering and production work, has resigned to engage in consulting engineering practice in New York. He will continue to serve The Dorr Company among other clients.

Fred Marston, formerly with the Caucasus Copper Company in Russia and the Ergasteria Flotation Company in Greece, is now manager of the Molybdenum Gold Mining Company, of Mammoth, Ariz., a subsidiary of the Molybdenum Corporation of America.

Charles V. Harris is now mill superintendent for Sunrise Mining Company at its 2-ton amalgamation and concentration camp, half a mile west of Wickenburg, Ariz. The ore is trucked 18 miles from the mine, where there is no water, to Wickenburg. **A. W. Harris,** formerly with Phelps Dodge at Bisbee, is acting as master mechanic at the Sunrise plant.

Andrew Meyer and **Mrs. Meyer** have concluded their work in the Altai Mountains, where they had been engaged as consulting mining and metallurgical engineers, respectively, at one of the properties of the Polymetal Trust of the Soviet Union. They will make an extended tour through Central Asia, visiting Tashkent and Samarkand, from there continuing on through the Caucasus and Crimea, spending a month at one of the famous resorts on the Black Sea. Mr. Meyer has placed the mine on an efficient basis, introducing American mining methods. Mrs. Meyer established a fire-assay laboratory and devised a method of recovering gold, which occurs in very appreciable quantities. Wily natives are said to wash gold out of the dust in the streets.

OBITUARY

Cyril J. Emery, general manager of North Broken Hill, Ltd., since 1928, died at Broken Hill on June 15, aged 58.

Miguel Bustamante, mining engineer, died recently at his home in Mexico City, Mex., aged 60 years.

T. R. Woodbridge, at one time a member of the firm of Taylor & Brunton, died in Upland, Calif., on July 18, at the age of 69.

John Kasser, who had long been identified with mining in the West, died on Aug. 27 at Bronxville, N. Y., at the age of 67.

Joseph Antoine Signoret, president of the Cia. Minera "Las Dos Estralles" en El Oro y Tlalpujahua, S. A., the National Bank of Mexico and a board member of various other companies in Mexico, died at his home in Mexico City on Aug. 13, aged 79 years.

Lieutenant-Colonel Sir Edgeworth David died on Aug. 28 at Sydney, Australia at the age of 76. Sir Edgeworth was British geologist on the Western Front during the War and had attained wide distinction as a scientist, author, traveler, and soldier.

Moritz Norden, president of the Rapidan Gold Corporation, at Fredericksburg, Va., died on Aug. 12. Mr. Norden was born in Germany, and was graduated from the University of Bonn. After mining in Mexico, he came to the United States, where he devoted himself to mining up to the time of his death.

John Faber Hanst, mining engineer, died in New York City on Aug. 16, at the age of 48. Mr. Hanst was a graduate of Lehigh University and had done professional work in the Michigan iron country and was later chief engineer of the Andes Copper Mining Company. He was a member of the A.I.M.E. and of numerous fraternal organizations.

John A. McCarthy, vice-president of the Anaconda Sales Company, selling organization of Anaconda Copper, and NRA Code Authority member in the lead industry, died suddenly from a heart attack on Aug. 25 at his summer home in Sayville, Long Island. He was 61 years old. During the last year he had given much of his time to the drafting of the lead and zinc codes. Besides being associated with Anaconda and other metal interests for more than 44 years, Mr. McCarthy was vice-president of the Copper Export Association, a member of the executive committee of the American Bureau of Metal Statistics and the American Zinc Institute, and a director in the Lead Industries Association. He had also devoted much time and labor to the development of new uses for copper and brass.

John A. McCarthy

LETTERS

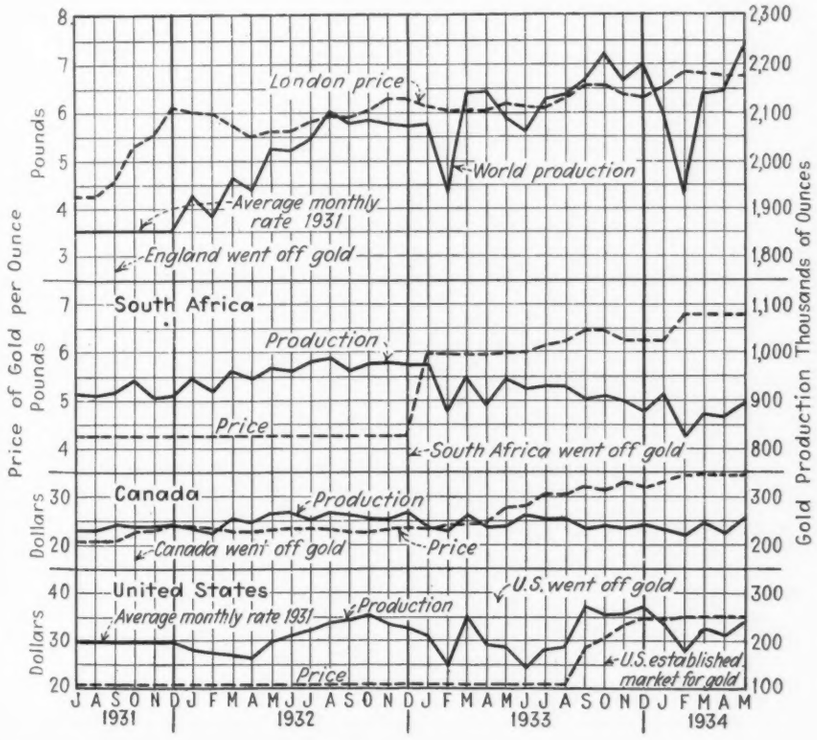
Gold Production and Prices

The Editor:

In the August, 1933, issue of *Engineering and Mining Journal* H. D. Keiser presented an interesting discussion of current problems in gold production, illustrated by curves showing the production and ruling prices of gold in South Africa, Canada, and the United States. So much of interest was presented in this comparison that, in view of subsequent developments, I have brought the data down to date in the accompanying chart, supplemented by the addition of a fourth pair of curves, showing world production and the London or world price.

The three countries mentioned produce about two-thirds of the world's gold output, and the conditions prevailing in them, and in the London market, are the controlling factors in the industry.

All three of the producing countries and the London market are now out from under the limitations of the gold standard and the fixed price which it imposed, and to study and compare the curves of production and price is both interesting and instructive, as is the tracing of the influence of the successive breakings away from the fixed price for gold, first in London and shortly thereafter in Canada, and then in South Africa, and finally, and more recently, in the United States.



Unfortunately, monthly production figures are not available previous to 1932, except for Canada and South Africa, so that the effects during the first three months of England's going off gold cannot be traced in either the United States or the world output statistics, but, judging from the curves for Canada and South Africa, the effect was probably not marked during that period.

Beginning with January, 1932, the world production curve shows a decided reaction to the increased price, and the curve, except for the periodical dips caused by the short month of February, has a decided upward trend to October, 1933. At that time the United States had just established its market for gold at the advanced price, and only since February, 1934, has the downward trend established at that time become broken. The London price advanced rapidly after England abandoned the gold standard, from the fixed price of approximately £4.25 to about £6; then it fell somewhat below the latter figure during the spring and summer of 1932, to rise slightly above this figure from then until the United States abandoned gold, when it rose again, finally reaching a level of about £6.75.

In South Africa the reaction has been rather curious. Production increased materially under the stimulus of the increased world price, but when South Africa itself went off gold, and the local price immediately rose to approximately the London price level, a decline of output set in which has been offset only since February of this year.

Canada followed England shortly in leaving the gold standard, but the Canadian price did not go up nearly so rapidly as the London price; whereas the London price passed £6 at the end of 1931, the Canadian price did not pass $30 until midyear of 1933. Canadian production also reacted slowly to the higher price, but in the summer of 1932 reached a level which was equivalent, on a percentage basis, to an increase about double that in South Africa; and, as in South Africa, production declined in 1933.

The United States did not jettison the gold standard until April, 1933, and did not establish a market for gold at an increased price until about five months later. Production in early 1932 was below the 1931 level, and not until April, 1932, did the output begin to react to the increased world price; a maximum was reached in October, followed by a decline even more rapid than the increase had been. After the United States prohibited the export of gold, in April, 1933, which resulted in producers no longer being able to secure the benefit of the increased world price, production dropped again. Output recovered, however, as establishment of a home market at an increased price became apparent, and production reached a higher point than it had in 1932.

These are only a few of the most outstanding characteristics that one can

read in these curves. The close student of gold affairs can doubtless read from them other interesting points, and the information that can be obtained from them seemed to justify the labor of bringing the curves up to date.

Bethlehem, Pa. G. A. ROUSH.

A Suggestion for Tunneling

The Editor:

Some ten years ago I volunteered some suggestions to you along the line of retrieving the breaking rock at a tunnel face and loading it into cars without allowing it to fall to the ground. Recently I have again been thinking about this matter, and thought you might be interested in the new proposal which, I imagine, is constructive and timely with regard to future mining and tunneling for highways, railroads, and underground power lines. Broadly, the suggested system is one that involves blasting the round so scientifically that it is automatically loaded into a tramway bucket system while the blasting is in progress, the loading being completed practically simultaneously with the firing of the last shot. I have not thought out details, but the principle of operation and the apparatus used comprise at least the following:

The round is drilled and loaded for electric detonation from a remote point in predetermined sections such that each section yields a bucket load of broken rock. Before firing, a tram car without the usual ends, but equipped with power-driven belts inlaid in the sides, and with a third elevating one disposed in the place of the usual car bottom, is pushed up snugly against the face and planted there with rugged shields in place to protect vulnerable parts against the force of the blasts. This belt-lined loader car receives the broken rock just a few inches above the tunnel floor, and transports it back a few feet and up to the height of a tall tram car. The process is continuous during the firing of the round, which is accomplished in a few minutes, the exact time depending on the prearranged time interval between the blasting of sections.

The broken rock is received into the top bucket of a nest of buckets suspended from a comparatively short aerial tramway, the tramway being mounted on four-wheeled trucks on the usual tunnel track. As each bucket completes its loading, it is drawn back away from the loader automatically, suspended at all times from an overhead rail or cable of the tramway. This maneuver is possible, as both front and rear ends of the bucket are hinged gates. They are also preferably of the bottom-dump type, and the localized overhead switching is assumed to be such that once the tramway, with its dozen or so loaded buckets, has arrived at the dumping ground beyond the portal, all the buckets can be dumped and re-nested at any point along the tramway.

A sturdy air conditioner for restoring the freshness of the local body of air may be set in operation during and for a short time after blasting to remove the powder fumes. If desired, the exhaust of compressed air drills can be put through the conditioner during drilling of the round.

The advantages of such a scientific system appear to be advanced speeds of progress, new cost economies, and better working conditions for the miner.

J. E. RYPINSKI.

Washington, D. C.

Editor's note: The reader will doubtless find flaws in Mr. Rypinski's proposal, the details of which he confesses he has not thought out. Nevertheless his ideas may stimulate new thought on the subject. Correspondence is invited.

Federal Aid to Gold Mining

The Editor.

The present condition of the gold-mining industry seems to call more than ever for a broad, comprehensive plan of organized development, beyond any scheme of temporary relief, if in the future it is to function as a major industry.

Gold mining is different from any other industry in that although the market for its product is unlimited, the source of supply is both limited and concealed. The future of gold mining depends upon the location of deep ore-bodies by thorough, intelligently directed scientific methods, including geophysical surveys and core-drilling, and upon an economic organization that will efficiently and equitably carry the cost of this work and at the same time restore the confidence of investors in an industry which they have far too much reason to believe has been engaged in mining the public rather than the ground.

It has been proposed in behalf of mining that the federal government should subsidize the industry to the extent of $100,000,000. This sum properly distributed would of course prove of tremendous value, but it is difficult to conceive that full value could be realized from it; and it is certain that, the money gone, gold mining would find itself leading essentially the same precarious, haphazard, hand-to-mouth existence it leads today. However, the same amount of money, or a fraction of it, spent in the creation of a permanent federal agency to assist in the planned expansion of the industry on a self-sustaining basis could do far more good than a direct subsidy of any size within the limit of possibility. Canada has proved it, and it is to be hoped that the mining men and legislators of this country are not too blinded by prejudice to consider what features of the Canadian system can be applied profitably to our own country, especially at a time when all national industries are coming under governmental supervision.

Not the least important feature of the Canadian system is the emphasis it places upon prospecting. Every prospector is licensed, for the nominal fee of five dollars a year, without restriction as to nationality. He is required to register in the mining district in which he is working, and to inform the authorities of his whereabouts at all times. Thereafter he receives every possible assistance. He is visited at regular intervals and receives aid in the event of illness or accident. Upon request he gets competent geological advice from government engineers. Trails or bridges necessary to the development of his claim are constructed for him. In special cases he may receive even further assistance of a material nature.

When his prospect reaches the investment stage, accurate, unbiased, full information on it is available to all from the Ministry of Mines, which naturally precludes the dissemination of unduly exaggerated publicity. There is, however, no restriction upon investment in any enterprise. Wildcats and long-shot gambles must be labeled as such, but if this hampers the activities of unscrupulous stock promoters it also renders easier the development of legitimate enterprise; the net result is that an operator with real value behind him obtains public confidence instead of public suspicion and can finance his project at reasonable cost, while speculative ventures are allowed to run their course to success or failure without casting the reflection of their nature upon the industry as a whole.

The cost of this government service to mining, which of course is not confined to gold mining alone, is borne by a royalty on the gross assay value of ores produced, in compensation to the government for the granting of mineral rights; in addition, the operator refunds to the government any expenditures made by it beyond geological service during the development period. In this way the industry as a whole pays for its expansion without any serious inroad on its profits, as the non-profit-producing investment in unsuccessful prospects is carried by the government out of its royalties.

The Lemhi system, first introduced in Lemhi, Idaho, of cooperation between smelters and organized mine owners to secure unbiased engineering advice to assist in the development of properties, has been quite successful where tried. It is practicable, however, only in small associations and does not offer half the advantages it might if it could embrace all mining throughout the country. It is nevertheless a step in the right direction and an indication of what may be accomplished through complete organization and sympathetic federal supervision.

I do not feel it to be within the scope of this brief discussion, which is intended to suggest rather than to inform, to point out in detail all of the possibilities inherent in the idea of federally supervised, organized mining. I consider it particularly applicable to gold mining, but many other branches of mining might well be included.

Its salient features should be encouragement of prospecting and the protection of legitimate enterprise. There is still gold in the ground; it is my hope to see it produced again in such quantities and on such a plane of integrity that the incident which occurred last October in Johannesburg, South Africa, may be duplicated in our gold-mining States. A new mining venture which needed $800,000 in developing capital was oversubscribed to the amount of $14,040,000.

V. A. TAMNEY.

Sacramento, Calif.

NEW BOOKS

Applied Geology

COURS DE GÉOLOGIE APPLIQUÉE. *By Louis de Launay. Notes taken and arranged by Henri Vincienne. Librairie Polytechnique Ch. Beranger, Paris, France. Pp. 460. Price, 90 francs, plus postage, 7 francs.*

This book has the advantages and drawbacks of being a simple record of a course of lectures, the lecturer being one of wide experience in the chosen subject. It has the merit of continuity and an ease of style which makes for continuous reading and gives an interesting perspective of a great range of mineral resources.

The book opens with some general considerations of those factors which affect the workability of any mineral deposit, and these are followed by a section on the manner of occurrence and genesis. Then follows the main portion of the book, in which the mineral commodities are taken up in alphabetical order.

For each mineral resource, the record of Professor de Launay's remarks is supplemented by well-consolidated statistics of world production, compiled by M. Vincienne. However, the two, in many instances, cannot be reconciled. The book purports to give a review of the whole mineral industry, and one may therefore expect a reasonable balance between the commercially important and trivial deposits, especially where adequate descriptions are available. Unfortunately this balance is lacking, as the following instances show:

Under fluorite no mention is made of the Rosiclaire deposits, although the figures of United States production are given. In discussing sulphur, although the Sicilian deposits are well covered, the United States Gulf Coast region is scantily treated, and the author appears to be unaware of the occurrence of salt domes in the region. In the chapter on oil, the United States is again treated with little balance and with numerous serious errors. A map shows a line of Caledonian folding running as a prolongation from the Appalachians through Texas and from there north to a little west of Lake Winnipeg. Again no recognition is made of salt-dome structures affecting oil accumulation, and very inadequate treatment is given to the Mid-Continent and California fields. Natural gas is assigned one page, of which only three lines pertain to recent developments in the United States, and nothing is presented on the development of pipe-line transportation. Boron receives two pages, but no mention is made of the Kramer, Calif., deposits.

Under vanadium are given the figures of production of Peru, but no mention is made of Minas Ragra. In discussing molybdenum the deposits at Climax, Colo., for some years producing more than 90 per cent of the world supply, are not mentioned. The chromite deposits of the Transvaal appear to have escaped notice. Iron is treated very fully and in an interesting fashion, but the Lake Superior district receives amazingly inadequate treatment. In covering copper, de Launay shows a complete lack of appreciation of the development of the "porphyry" coppers, both from the geological and the engineering point of view. The Northern Rhodesia deposits are not mentioned. Twenty-eight pages are given to lead and zinc, but the Tri-State and Southeast Missouri districts receive six lines in all.

In spite of its many shortcomings, the book is of interest, especially to non-European readers, for the large amount of information given concerning regions not covered in most books on economic geology. EDWARD SAMPSON.

Silicosis Bibliography

THE PNEUMONOKONIOSES (SILICOSIS)—BIBLIOGRAPHY AND LAWS. *George G. Davis, M.D. (Associate Professor of Clinical Surgery, University of Chicago Medical College), Ella M. Salmonsen (Medical Reference Librarian, John Crerar Library, Chicago), Joseph L. Earlywine (Attorney, Chicago). Published by Industrial Medicine, Inc., Chicago. Pp. 482. Price $7.50.*

This book cites 2,770 references from the world's literature on the subject covered, dating from the year 1556 A.D. to Jan. 1, 1934. The references are grouped year by year under headings relating to industries, products, processes, diseases, occupations and similar subjects.

Each reference is numbered, gives the author's name, the original title in the language in which it is published, the name of the publication, volume, page, and year, and the name of the publisher if a book is mentioned, 276 pages being required to list all of such references. A cross-reference subject index of bibliography numbers is well presented in the succeeding 30 pages, and 12 pages more are devoted to listing under reference group headings the years and pages in this book referring to each subject. An index of authors with a reference-year index completes in 346 pages the bibliographic portion of this book. Though about 1,338 of the references are to English texts, there are also many to German, French and Italian journals, and a few are noted from Latin, Russian, Norwegian, Swedish, Polish and Japanese.

Only one textbook in physiology is given as a reference. Many other reference books should be cited in regard to the anatomy and physiology of the respiratory tract and processes; also texts on biophysics and biochemistry. The citations on dust-collecting and sampling apparatus should be increased.

The last 136 pages of the book are devoted to occupational disease laws, workmen's compensation laws, and common law of the states of the United States. Only the states of Illinois, Ohio, and New Jersey are cited as having occupational disease acts, but the statutes of each of the other states are briefly digested where their subject-matter is pertinent to occupational diseases; and 126 court decisions are cited briefly. B. F. TILLSON.

Ore Deposits of France

RÉPERTOIRE DES MINES ET GISEMENTS DE FRANCE ET DE L'AFRIQUE DU NORD. *Edited by Léon Laffitte and V. Charrin, director and engineer of the French Bureau of Mines, respectively. Published by Mines, Carrières, Grandes Enterprises, Paris. Pp. 700. Price 100 Fr.*

A listing of the mines and mineral deposits of France and French North-Africa, giving situation, extension, production, and other data of interest. The properties are arranged in alphabetical order and according to districts. In addition the book contains a list of the operating staffs of the mines, and the names and addresses of about 2,000 mine owners. A chapter is also devoted to the French mining laws.

Publications Received

Les Ressources minérales de la France d'outre-Mer. II—La Fer, le Manganese, le Chrome, le Nickel, l'Etain, le Tungstène, le Graphite, le Glucinium, le Molybdène, le Cobalt, le Titane, le Vanadium. Publications du Bureau d'Etudes géologique et Minières coloniales. Paris, 1934: Société d'Editions geographiques, Maritimes et Coloniales, 184, Boulevard Saint-Germaine, Paris, France.

Map of Part of Gold Coast Colony and Ashanti, showing position of gold and diamond properties. Compiled by C. D. Syndicate, Ltd., 107 Moorgate Station Chambers, Moorfields, London, E. C. 2, England. Price, 3s. 6d.

Transvaal Chamber of Mines. Forty-fourth Annual Report, Calendar Year 1933. Official statements and statistics.

Employer-Employee Relations. A semi-monthly bulletin for business executives, relating to labor problems and their solution. Vol. 1, No. 1, July 15, 1934. Published by Bureau of Personnel Administration, Graybar Building, New York, N. Y. Per annum $15.

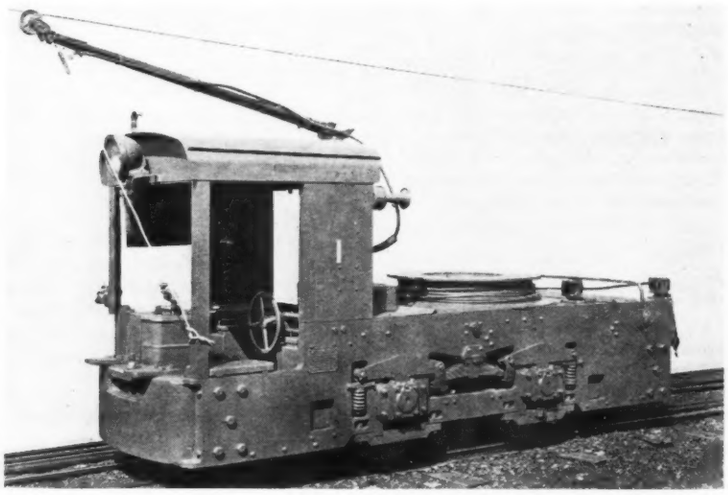
Engineering Geology and Mineral Resources of the Tennessee Valley Authority Region. Geologic Bulletin No. 1, Tennessee Valley Authority, Knoxville, Tenn. By Edwin C. Eckel, Geologist, T.V.A.

EQUIPMENT NEWS

Electric Locomotives of Special Design

Meet Severe Working Conditions Satisfactorily at an Indian Salt Mine

Electrification of underground haulage having been decided upon by the Government of India for one of its salt mines at Khewra, in the Jhelum district, a 250-volt d.c. overhead trolley wire was installed and three 18,000-lb. locomotives, of the type shown in the accompanying illustration, were ordered from the International General Electric Company, Schenectady, N. Y. Two were to be used for main haulage, and the third was employed for switching and gathering. Each had 600 ft. of cable on a motor-driven reel. The track gage is 30 in. and the wheel base 46 in., the latter being required because of traction curves of 25 ft. radius.



One of the three 8-ton, 250-volt, 30-in.-gage mine locomotives in service in a salt mine in northwestern India.

Severity of climatic conditions at Khewra necessitated extraordinary specifications. Maximum outdoor temperatures are 170 deg. F. in the sun and 120 deg. F. in the shade. Humidity is high. The area outside the mine is subject to severe storms which fill the air with dust and fine sand. Inside the mine workings the atmosphere is heavily charged with salt.

To shield the operator from the sun, a new design of open cab was devised. The steel roof was insulated with vegetable wool, protected on the inside by a thin sheet steel ceiling. The high temperature was a factor also in determining the proper traction motors. For protection against dust, totally enclosed motors were selected and other equipment was provided with dust-type covers.

The factor of most influence on design was the salt-saturated atmosphere combined with the tropical temperature and the humidity. This required extraordinary precautions to protect the entire locomotive against corrosion. Non-corroding and non-hygroscopic materials were substituted for standard materials in many parts, and various special treatments and finishes were employed. Stainless steel pins replaced those of ordinary steel in the control mechanism, and non-wearing steel parts of the control were either plated or rust-proof. All copper and brass parts were treated to protect them against corrosion. Liberal use was made of Glyptal synthetic rosin finishes, these being especially valuable with respect to salt corrosion, high temperature and humidity. Such finishes were applied to all parts, including the inside of the traction motors and the outside of the locomotive structure.

Fundamentally, the design and construction of the mechanical structure followed the General Electric Company's mine locomotive standards. Two motors are employed, each 40 hp. 250 volts, and of the totally enclosed mine-locomotive type. The controller is of the series-parallel drum type with five steps of rheostatic braking and a specially designed deadman's handle. The trolley is of the standard wood-pole, mine-locomotive variety, with a spring-returned swiveling harp. Cable reel equipment is likewise standard but with a longer length of cable than usual.

To summarize, the principal features of special design which contribute to making these locomotives novel are: special finishes and protective coatings; special corrosion-resisting materials; a heat-insulated cab; a new type of deadman's controller handle; all-rubber insulation for wires and cables; wiring enclosed in a special steel conduit; an unusual degree of electrical protection, including main and auxiliary fuses at the head of every circuit, overload relay, and lightning arrester; an automatic transfer switch between trolley and cable reel; a main resistor of extra capacity; and, finally, electric meters in an illuminated gage panel.

The 30-in. gage railway, on which these locomotives were used, climbs from the salt depot to a point about a mile away, where it enters the mine through a tunnel. The daily mine output was handled in 15 round trips for each train.

Variable-Speed Transmission for Low-Duty Drives

A novel, self-adjusting, positive, variable-speed transmission for fractional horsepower duty, known as the Link-Belt V.R.D. (variable roller drive), is announced by Link-Belt Company, as a companion to the P.I.V. gear variable-speed transmission used for larger capacities.

Heavy-Duty Compressor Exhauster

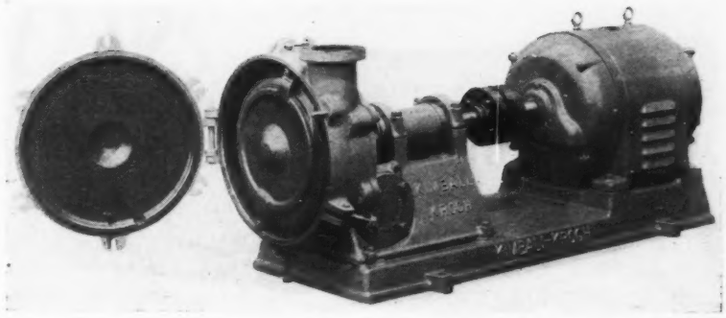
Design of a new centrifugal compressor-exhauster, built by the Roots-Connersville Blower Corporation, Connersville, Ind., provides the machine with its own shafts and bearings, so that it is suitable for direct connection to standard electric motors or steam turbines without special shaft extensions. It is also adaptable to V-belt or flat belt drive. The new unit is single stage and is known as Type "OIB." Impellers are of aluminum or carbon steel, but may be made of special alloys if desired. In the smaller sizes they are of the open type. The machine is sturdily built, according to the manufacturer, fitting it for heavy-duty work in a wide variety of applications.

Saves Flour Gold

Equipment for recovering gold from sands and gravels has been developed by Flour Gold Machines, Inc., 2436 Washington St., Lincoln, Neb. Statement is made that it will recover fines or flour gold. Essentially, the equipment includes a revolving screen, in which the gravel is washed, and which is followed by a revolving drum covered with a fine screen and suspended in water with the lower half submerged. The fines settle through the meshes of the screen into a tank, from which they are passed to a centrifugal bowl amalgamator, in which the recovery of the gold is made.

A New Tailings Pump

A new centrifugal pump for handling abrasive material has been introduced by the Kimball-Krogh Pump Division of Victor Equipment Company, Los Angeles, Calif. It is said to show good efficiency and to cost little to maintain. Accessibility and an ingenious wear take-up adjustment are outstanding features of the design. For instance, removal of the hinged end plate of the pump body affords instant access to the removable wearing parts inside the casing without disturbing the pipe connections on either the suction or discharge openings. The wear take-up arrangement, moreover, makes possible quick adjustment to restore full pump capacity. The impeller is furnished with a wear ring on the suction eye, which, in case of wear, may be moved toward the suction nozzle (also equipped with a ring) by the wear take-up adjustment to sustain the capacity. This adjustment can be repeated until the rings are completely worn away. Parts inside the casing subject to excessive wear are made from a special iron alloy of 400 Brinell hardness. The impeller is made from a similar material of 500 Brinell hardness. The pump is made in four sizes, ranging from 2 in. to 6 in.



Removal of the hinged end plate of this sand and tailings pump gives instant access to the removable wearing parts

Improved Air Hose

Two new types of air hose have been developed by the Electric Hose & Rubber Company, Wilmington, Del. One is intended for use with portable compressors and has a lining made of a special compound which is resistant to internal heat, and, according to manufacturer, will not disintegrate or peel from constant contact with oil. The other is a rock-drill hose. It is covered with an extra heavy layer of rubber specially compounded and cured to resist abrasion and cutting when being dragged or rubbed over rough surfaces. The tube is specially made to resist oil and heat. Both types are reinforced by tightly twisted cords braided around the tube and surrounded by rubber.

Light-Weight Drifter

The newest rock drill is a drifter developed by the Gardner-Denver Company, Quincy, Ill., which weighs only 126 lb. and can be equipped with spring handles for use also as a sinker. Features of design include an automatic valve, which gives high speed with low air consumption; a special long-wearing bronze removable front cylinder liner; direct center exhaust; a sturdy throttle valve with outboard bearing; and threepoint cross-head support. It is provided with an integral lubricator.

A 126-lb. drill for drifting and sinking

INDUSTRIAL NOTES

Allen-Sherman-Hoff Company has installed several Hydroseal pumps in the Kirkland Lake district, Ontario. L. F. Hoag has returned to Philadelphia after completing this work.

Chicago Pneumatic Tool Company, New York, has purchased the patents, good will, and tangible assets of the Mitchell Diamond Drill Company, Ltd., San Francisco, and has taken over its personnel. For the time being, the manufacture of Mitchell diamond drills, parts and fittings, as well as "ready-set" bits, will be continued at San Francisco.

St. Joseph Lead and the Kelley-Atwell Development Corporation have organized the Kadco Corporation, 30 Rockefeller Plaza, New York. Kadco has acquired all patents, equipment, and plant of the Kelley-Atwell company and will continue to develop and produce Kadco dust-control equipment.

The Bucyrus-Erie Company, South Milwaukee, Wis., has appointed the Crook Company, Los Angeles, as distributor of its power shovels, draglines, cranes, and clamshells in southern California.

American Cyanamid & Chemical Corporation, New York, has merged the businesses of the following companies into the American Cyanamid group and will operate them as divisions of the corporation: American Cyanamid Sales Company, American Powder Company, Catalytic Process Corporation, Fumigation Service, Inc., Fumigators Supply Company, Inc., General Explosives Corporation, Gypsteel Construction Company, Inc., Maryland Chemical Company, Inc., Owl Fumigating Corporation, the Selden Company, the Selden Research & Engineering Corporation, and Structural Gypsum Corporation.

Southwestern Engineering Company has been organized to handle the business of the Southwestern Engineering Corporation, Los Angeles, which went into receivership some time ago. Horace G. Miller is president and general manager, G. W. Clemson vice-president, and Janet Rattray secretary-treasurer. E. R. Cullity will be in charge of the mining department.

Blazeite Powder Company has been organized by S. H. Bunker and L. J. Whitehill, of Newport, Vt., and T. V. Blaisdell, of Lyndonville, Vt., to manufacture a new blasting powder. Harry S. Joseph, of Salt Lake City, is also interested. According to the latter, a Utah company is to be organized to make the new explosive for Western territory.

BULLETINS

Pneumatic Tools. Ingersoll-Rand Co., New York. Pamphlet 2037-A. Pp. 8.

Treatment of Respiratory Failure. Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin CA-1, covering the H-H inhalator. Pp. 4.

Roller Bearings. Shafer Bearing Corp., Chicago, Ill. Catalog 12, covering self-aligning roller-bearing units. Pp. 50.

Ball Mills. American Ball-Mill Co., Patterson Building, Denver, Colo. Bulletin J-1, entitled "Facts About the Modern Trend in Ball Mills."

Electric Instruments. General Electric Co., Schenectady, N. Y. Catalog GEA-602D. Pp. 161.

Redler Continuous Flow Conveyors. Stephens-Adamson Mfg. Co., Aurora, Ill. Pp. 16.

Horizontal Non-Clogging Pumps. Economy Pumping Machinery Co., 3431 W. 48th Place, Chicago, Ill. Bulletin F434. Pp. 8.

Precision Balances. Roller-Smith Co., New York. Catalog 240, covering balances for weighing; also for determining surface tension, specific gravity, and for other purposes. Pp. 8.

Power Transmission. Dayton Rubber Mfg. Co., Dayton, Ohio. Catalog 160, covering Dayton V-flat drives. Pp. 16.

Arc Welding. Lincoln Electric Co., Cleveland, Ohio. Bulletin entitled "The Shielded Arc." Pp. 12.

Power Transmission. D. O. James Mfg. Co., Chicago, Ill. Catalog No. 137, covering continuous-tooth herringbone speed reducers and gears. Pp. 96.

Coal Crushers. Pennsylvania Crusher Co., Philadelphia, Pa. Bulletin 2005, covering Pennsylvania Steelbuilt single-roll crushers, Pennweld series. Pp. 6.

Structural Metal Painting. National Lead Co., New York. A 3¼x5¾-in. instruction book of 160 pages by A. H. Sabin and F. M. Hartley.

Welding. Linde Air Products Co., New York. Pamphlet on "The Testing and Qualification of Welders." Pamphlet. Pp. 23.

How to Select Insulated Cable. General Electric Co., Schenectady, N. Y. Bulletin GEA-1837. Pp. 80.

Micro Regulating Valves. Hauck Manufacturing Co., 126 Tenth St., Brooklyn, N. Y. Folder on valves for regulating flow of liquids, including oil (to burners)

Excavating Equipment. Harnischfeger Corporation, Milwaukee, Wis. Anniversary Book commemorating the completion of fifty years of business life. Entitled "The Fiftieth Year." Pp. 84.

Mill Supplies. Green, Tweed & Co., 109 Duane St., New York. Catalog 16, covering several brands of packing, the Favorite reversible ratchet wrench, the Basa soft-faced hammer, the Empire rawhide mallet, and the Rochester automatic force feed lubricator; also other specialties. Pp. 64.

Copper-Lead-Tin Bearing Metal. Cu-Lead-Ite Bronze Bearing Metal Co., Hollywood Security Building, Los Angeles, Calif. Leaflet describing Cu-Lead-Ite bronze, a complete amalgamation of copper, lead, and tin, and known as high lead bronze. (Heretofore unknown non-metallic fluxing elements are said to be used in making it, which prevents segregation of the lead when combined with copper in any quantity. The bronze is said to be non-seizing and non-scoring.)

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

WITH general industrial activity in August at a lower level than in the preceding month, the movement of non-ferrous metals into consumptive channels naturally suffered. Buying was retarded because of the uncertainty over the future policy of the NRA, labor difficulties in a number of major industries, and the less favorable international picture created by the trend toward national self-sufficiency.

President Roosevelt's order nationalizing silver was made public on Aug. 9, and resulted in halting all trading, temporarily at least, in silver futures. The open-market quotation for the metal was raised to conform with the price named by the Treasury. The future course of silver abroad will depend largely on the American program.

Domestic copper buying was inactive but sufficient in volume of business done to support the marketing structure set up in the Code. The price remained at 9c., Valley. In spite of the unsettlement in the business outlook, producers have not given up the idea of raising the price in the not too distant future. United States deliveries of copper for the month of July totaled 30,000 tons, against 46,500 tons in June. Stocks of refined copper held by members of the Copper Institute were reduced in July to 496,500 short tons, a decline of 5,500 tons for the month. The foreign market has been greatly disturbed by the developments in Germany and the apparent upward trend in production outside of the United States. Our quotation for "export" copper settled at 6.75c., c. i. f. European ports, as against 6.95c. a month previous.

Refined lead stocks in the United States increased to 240,595 tons during July, which served to keep down the price to the comparatively low level of 3.75c., New York, and 3.60c., St. Louis. The price developed a little weakness on Aug. 24, but orders for lead on the 5-point decline were fairly large, and the market soon recovered.

Zinc sales volume was below the average for the year and the price declined toward the close, business passing on the last day of August at 4.20c., St. Louis.

The *E.&M.J.* index of non-ferrous metal prices for August was 70.86, against 70.19 in July and 67.98 in August, 1933.

United States Market

	Electrolytic Copper		Copper	Straits Tin	Lead		Zinc
	Domestic		Export	New York	New York	St. Louis	St. Louis
Aug.	(a)	(b)	(c)				
1	9.00	8.775	6.925	51.700	3.75	3.60	4.300
2	9.00	8.775	6.925	51.650	3.75	3.60	4.300
3	9.00	8.775	6.925	51.700	3.75	3.60	4.300
4	9.00	8.775	6.975	51.700	3.75	3.60	4.300
6	9.00	8.775	6.975	51.725	3.75	3.60	4.300
7	9.00	8.775	7.000	51.700	3.75	3.60	4.300
8	9.00	8.775	6.975	51.750	3.75	3.60	4.300
9	9.00	8.775	6.950	52.275	3.75	3.60	4.300
10	9.00	8.775	7.000	52.000	3.75	3.60	4.300
11	9.00	8.775	7.000	52.050	3.75	3.60	4.300
13	9.00	8.775	6.975	52.900	3.75	3.60	4.300
14	9.00	8.775	6.975	52.750	3.75	3.60	4.300
15	9.00	8.775	6.925	52.350	3.75	3.60	4.300
16	9.00	8.775	6.875	52.150	3.75	3.60	4.300
17	9.00	8.775	6.875	52.350	3.75	3.60	4.300
18	9.00	8.775	6.850	52.250	3.75	3.60	4.300
20	9.00	8.775	6.800	52.200	3.75	3.60	4.300
21	9.00	8.775	6.750	52.025	3.75	3.60	4.275@4.300
22	9.00	8.775	6.775	52.050	3.75	3.60	4.250@4.275
23	9.00	8.775	6.800	51.950	3.75	3.60	4.250
24	9.00	8.775	6.850	51.725	3.70	3.55	4.250
25	9.00	8.775	6.825	51.750	3.70@3.75	3.55@3.60	4.250
27	9.00	8.775	6.825	51.950	3.75	3.60	4.250
28	9.00	8.775	6.800	51.700	3.75	3.60	4.250
29	9.00	8.775	6.800	51.450	3.75	3.60	4.250
30	9.00	8.775	6.800	51.425	3.75	3.60	4.225
31	9.00	8.775	6.750	51.500	3.75	3.60	4.200
Av. for month		8.775	6.885	51.953	3.747	3.597	4.281
Averages for Week							
1		8.775	6.950	52.042	3.767	3.617	4.300
8		8.775	6.963	51.704	3.750	3.600	4.300
15		8.775	6.971	52.388	3.750	3.600	4.300
22		8.775	6.821	52.171	3.750	3.600	4.292
29		8.775	6.817	51.754	3.738	3.588	4.250
Calendar Week Averages							
4		8.775	6.942	51.825	3.750	3.600	4.300
11		8.775	6.983	51.917	3.750	3.600	4.300
18		8.775	6.913	52.458	3.750	3.600	4.300
25		8.775	6.800	51.950	3.738	3.588	4.267

Silver, Gold, and Sterling Exchange New York and London

	Sterling Exchange		Silver		Gold	
		"90-day	(d)			(e) United
Aug.	"Checks"	Demand"	New York	London	London	States
1	5.03000	5.03125	46.375	20.4375	138s 1 d	$35.00
2	5.03250	5.03375	46.625	20.5625	138s 2 d	35.00
3	5.03625	5.03750	46.750	20.5000	138s 1½d	35.00
4	5.04250	5.04375	47.000	20.6875	138s ½d	35.00
6	5.04000	5.04125	47.000	Holiday		35.00
7	5.06125	5.06625	47.375	20.8125	137s10 d	35.00
8	5.05375	5.05750	48.000	20.9375	138s ½d	35.00
9	5.04750	5.05125	49.250	21.4375	138s 1 d	35.00
10	5.08750	5.09375	49.750	21.4375	138s 1 d	35.00
11	5.10250	5.10625	49.750	21.5625	138s 1½d	35.00
13	5.10125	5.10500	49.750	21.5625	138s 3 d	35.00
14	5.09750	5.10125	49.750	21.6250	138s 2½d	35.00
15	5.07000	5.07750	49.750	21.7500	138s 4 d	35.00
16	5.08000	5.08125	49.750	21.6250	138s 1½d	35.00
17	5.09750	5.10000	49.750	21.5625	138s 3½d	35.00
18	5.09125	5.09250	49.750	21.6250	138s 4 d	35.00
20	5.08500	5.08625	49.750	21.6250	138s 3 d	35.00
21	5.08625	5.08875	49.750	21.6250	138s 2½d	35.00
22	5.09125	5.09250	49.750	21.5625	138s 7 d	35.00
23	5.08500	5.08625	49.750	21.5625	138s 7½d	35.00
24	5.07000	5.07125	49.625	21.5625	139s 3 d	35.00
25	5.06500	5.06625	49.500	21.5000	139s 5 d	35.00
27	5.06125	5.06250	49.625	21.5625	139s 4 d	35.00
28	5.05500	5.05625	49.625	21.5625	139s 1½d	35.00
29	5.04125	5.04250	49.625	21.5625	139s 4½d	35.00
30	5.02250	5.02375	49.625	21.6875	140s 3 d	35.00
31	4.99375	4.99500	49.625	21.8750	140s11½d	35.00
Av. for month	5.06398	.....	48.986	21.377	.....	35.00
Averages for Week						
1	5.03438	.....	45.958	.....	.....	.....
8	5.04438	.....	47.125	.....	.....	.....
15	5.08438	.....	49.667	.....	.....	.....
22	5.08854	.....	49.750	.....	.....	.....
29	5.06292	.....	49.625	.....	.....	.....

Calendar week averages: New York Silver, Aug. 4th, 46.438; Aug. 11th, 48.521; Aug. 18th, 49.750; Aug. 25th, 49.688.

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per pound above our f.o.b. refinery quotation

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued Dec. 31, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(e) U. S. Treasury's gold price.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

August	Copper Standard Spot	Copper Standard 3 Mo.	Copper Electrolytic (Bid)	Tin Spot	Tin 3 Mo.	Lead Spot	Lead 3 Mo.	Zinc Spot	Zinc 3 Mo.
1	28.6875	29.0625	31.7500	229.0000	229.0000	10.8750	11.1875	13.3750	13.6250
2	28.7500	29.1250	31.7500	228.7500	228.7500	11.0625	11.3125	13.5000	13.7500
3	28.8750	29.2500	32.0000	228.6250	228.6250	10.9375	11.2500	13.6875	13.7500
6					Holiday				
7	29.2500	29.6250	32.2500	227.5000	227.5000	10.8750	11.1875	13.6250	13.7500
8	28.6250	29.0000	31.7500	227.2500	227.3750	10.7500	11.1250	13.5625	13.6875
9	28.6875	29.0625	31.7500	228.8750	228.8750	10.8750	11.2500	13.6250	13.7500
10	28.7500	29.1250	31.7500	227.7500	227.7500	11.1250	11.3750	13.6250	13.8750
13	28.6250	29.0000	31.7500	228.7500	228.7500	11.0000	11.3125	13.5000	13.7500
14	28.7500	29.1250	32.0000	230.6250	230.7500	10.9375	11.2500	13.5625	13.8750
15	28.3750	28.8125	31.5000	229.7500	229.7500	10.8750	11.1875	13.6875	13.8125
16	28.0000	28.4375	31.5000	228.2500	228.2500	10.7500	11.0625	13.6875	13.6875
17	28.1250	28.5000	31.2500	228.6250	228.6250	10.8125	11.0625	13.8750	13.8750
20	27.7500	28.1250	31.1250	228.5000	228.5000	10.7500	11.0000	13.8125	13.8125
21	27.6875	28.0000	30.7500	227.5000	227.5000	10.7500	10.9375	13.7500	13.7500
22	27.9375	28.2500	31.0000	226.2500	226.2500	10.7500	10.8750	13.7500	13.7500
23	28.1250	28.4375	31.2500	226.7500	226.7500	10.7500	10.8750	13.7500	13.7500
24	28.1875	28.5000	31.2500	226.8750	226.7500	10.6875	10.8125	13.8750	13.8125
27	28.1875	28.5625	31.2500	228.1250	227.7500	10.6875	10.7500	13.8750	13.7500
28	27.9375	28.2500	31.0000	227.1250	226.8750	10.6250	10.6250	13.6875	13.6875
29	28.0625	28.3750	31.0000	226.7500	226.2500	10.6875	10.6875	13.6875	13.6875
30	28.2500	28.6250	31.5000	228.0000	227.2500	10.8125	10.8125	13.8125	13.8125
31	28.2500	28.6250	31.5000	228.8750	227.6250	10.6875	10.6875	13.6875	13.6250
Av. for month	28.358	.....	31.483	228.114	.....	10.821	11.028	13.682	13.756

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(Sept. 1, 1934)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	23.30c.
Antimony, domestic and Chinese (duty paid), lb.	8.625c.
Bismuth, ton lots, lb.	$1.20
Cadmium, lb.	55.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$23.00
Platinum, (official quotation) troy oz.	$36.00
Quicksilver, flask of 76 lb.	$74.50@$75.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$1.80
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$15.50@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$35.00@$37.50
Manganese Ore, long ton unit:	
52@55 per cent	24c.
49@51 per cent	24c.
44@47 per cent	23c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$16.50@$17.00
Domestic Scheelite	$16.00@$16.50
Vanadium Ore, per lb. of contained V_2O_5	26c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$27.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	4c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk ton	$13.00@$15.00

Alloys

Beryllium-Copper, 12.5 per cent Be, 5 to 200 lb., lb.	$3.81
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$450@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32@ $37
Shorts	$11@ $15
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$5.00@ $6.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	@$16.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley, furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets and Sheet bars, gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1933	1934	1933	1934	1933	1934
January	25.400	44.188	16.883	19.382	336.060	504.644
February	26.074	45.233	16.885	20.073	342.114	503.085
March	27.928	45.875	17.588	20.278	343.138	509.259
April	30.730	45.180	18.440	19.740	357.565	515.210
May	34.072	44.226	19.046	19.276	393.106	510.510
June	35.663	45.173	19.078	19.981	413.216	504.721
July	37.630	46.310	18.341	20.512	464.760	503.990
August	36.074	48.986	17.877	21.377	449.944	506.398
September	38.440		18.272		466.240	
October	38.190		18.221		466.380	
November	42.974		18.428		514.573	
December	43.550		18.674		511.260	
Year	34.727		18.144		421.530	

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery — Electrolytic — Domestic		— Export	London Spot — Standard		— Electrolytic	
	1933	1934	1934	1933	1934	1933	1934
January	4.775	7.890	7.831	28.557	32.560	33.244	35.614
February	4.775	7.777	7.844	28.481	33.072	32.556	35.969
March	5.011	7.775	7.837	28.179	32.497	32.370	35.512
April	5.395	8.173	8.053	29.576	33.006	33.681	36.038
May	6.698	8.275	7.913	34.071	32.662	38.163	35.756
June	7.773	8.594	7.705	36.759	32.149	41.000	35.339
July	8.635	8.775	7.146	37.917	29.707	41.524	32.778
August	8.768	8.775	6.885	36.071	28.358	40.227	31.483
September	8.753			35.122		38.339	
October	7.950			33.656		36.977	
November	7.881			30.588		33.898	
December	7.885			31.306		34.329	
Year	7.025			32.524		36.359	

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1933	1934	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.000	4.000	2.875	3.900	10.458	10.833	11.304	11.517
February	3.000	4.000	2.875	3.900	10.431	10.719	11.634	11.913
March	3.146	4.000	3.021	3.900	10.609	10.821	11.545	11.842
April	3.260	4.179	3.135	4.042	10.872	11.122	11.500	11.794
May	3.654	4.140	3.525	3.990	12.095	12.372	11.051	11.341
June	4.173	3.975	4.023	3.825	13.280	13.571	11.054	11.253
July	4.452	3.772	4.303	3.623	13.411	13.613	10.813	11.045
August	4.500	3.747	4.350	3.597	12.182	12.457	10.821	11.028
September	4.500		4.350		11.932	12.229		
October	4.313		4.176		11.804	12.102		
November	4.288		4.146		11.537	11.778		
December	4.141		4.042		11.431	11.658		
Year	3.869		3.735		11.670	11.940		

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1933	1934	1933	1934
	Straits		Standard, Spot	
January	22.692	51.891	145.708	226.631
February	23.500	51.668	148.544	226.731
March	24.221	53.838	149.120	233.863
April	27.136	55.622	157.944	239.181
May	36.051	53.541	186.207	234.239
June	44.097	51.271	219.964	226.875
July	46.356	51.930	216.673	230.381
August	44.794	51.953	215.210	228.114
September	46.665		216.893	
October	47.858		223.455	
November	53.011		226.722	
December	52.936		227.678	
Year	39.110		194.510	

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.018	4.271	14.381	14.595	14.688	14.943
February	2.666	4.384	13.866	14.119	14.844	15.125
March	2.987	4.368	14.647	14.674	14.735	15.033
April	3.298	4.370	14.951	15.208	14.916	15.200
May	3.805	4.346	15.505	15.660	14.722	14.966
June	4.348	4.240	16.988	16.774	14.241	14.467
July	4.878	4.317	17.795	17.789	13.466	13.693
August	4.916	4.281	16.869	17.031	13.682	13.756
September	4.699		16.810	17.042		
October	4.748		16.310	16.599		
November	4.520		15.048	15.349		
December	4.461		14.826	15.059		
Year	4.029		15.666	15.825		

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1933	1934	1933	1934
January	55.000	55.000	23.300	23.300
February	55.000	55.000	23.300	23.300
March	55.000	55.000	23.300	23.300
April	55.000	55.000	23.300	23.300
May	55.000	55.000	23.300	23.300
June	55.000	55.000	23.300	23.300
July	55.000	55.000	23.300	23.300
August	55.000	55.000	23.300	23.300
September	55.000		23.300	
October	55.000		23.300	
November	55.000		23.300	
December	55.000		23.300	
Year	55.000		23.300	

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1933	1934	1933	1934	1933	1934
January	5.722	7.198	48.500	67.538	26.480	38.000
February	5.738	7.172	48.614	72.011	24.000	38.000
March	5.901	7.545	52.676	75.472	24.667	38.000
April	5.876	7.918	54.580	75.930	26.800	38.000
May	6.264	8.465	56.500	75.577	28.500	36.538
June	6.500	7.900	60.038	75.000	30.000	36.000
July	7.262	8.024	62.900	75.000	32.320	36.000
August	6.986	8.514	63.500	75.000	33.000	36.000
September	6.880		64.580		34.560	
October	6.843		66.500		36.000	
November	7.113		66.000		37.583	
December	7.250		66.330		38.000	
Year	6.528		59.227		30.993	

(a) Antimony quotations in cents per pound, or ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1933	1934	1933	1934	1933	1934
January	14.50	18.00	14.00	17.00	14.50	17.50
February	14.50	18.00	14.00	17.00	14.50	17.50
March	14.50	18.00	14.00	17.00	14.50	17.50
April	14.50	18.48	14.00	17.48	14.50	17.98
May	15.42	19.00	14.42	18.00	14.92	18.50
June	16.00	19.00	15.00	18.00	15.50	18.50
July	16.50	19.00	15.50	18.00	16.00	18.50
August	17.00	19.00	16.00	18.00	16.50	18.50
September	18.00		17.00		17.50	
October	18.00		17.00		17.50	
November	18.00		17.00		17.50	
December	18.00		17.00		17.50	
Year	16.24		15.41		15.91	

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.